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MACHINERY, EMPLOYMENT, AND PURCHASING POWER



ORGANIZED 1916

NATIONAL INDUSTRIAL CONFERENCE BOARD, INC.
247 PARK AVENUE
NEW YORK CITY



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FOREWORD

THIS volume presents the essential available facts regarding the general relation of machinery to unemployment, employment, production, and purchasing power of the American working population. It is the second, revised edition of a study prepared by the Conference Board's Research Staff, with the cooperation of the National Machine Tool Builders' Association, and issued in October, 1935. The first edition is exhausted, and, in reprinting, opportunity has been taken to revise some of the data and add new material. The need of more accurate and comprehensive information regarding the amount and character of involuntary unemployment is more particularly emphasized in this edition; but the general conclusions of the study regarding the relation of mechanization to economic progress are unchanged.

The mechanization of industry has made possible an increase in the variety of goods and services available to the community, an improvement in their quality, and an expansion in their volume far greater than the growth of population, together with a reduction in working hours, without diminishing the total of employment opportunities. These results are the substance of the great rise in the standard of life in the United States which is unparalleled in the human record, and they are the work of the machine, invented by human ingenuity, utilized by intelligent industrial management, and applied by private enterprise.

While the mechanization of industry has not diminished the need for human effort and the opportunities for work, it has been accompanied by great shifts in the occupations of men, women, and children. Such changes are the price of progress, and willingness to make them is a responsibility of both workers and employers under an enterprise organiza-

tion of economic life. They imply adaptation of both capital and labor to new needs; they entail dissipation of investments, relocation of industries, increased mobility of enterprise and employment, re-education and retraining of labor. Refusal or incapacity to make these incessant adjustments required by progress is the source of most of the problems and difficulties that the machine superficially appears to have created. They are not problems of the machine, but problems of men, and they can best be met, as they have been met, by the ingenuity, industry, enterprise, cooperative effort, and qualities of character of the men who have made and used the machine so successfully.

Among these problems the most important is that of the displacement of the less competent or less productive workers through the steady rise in the standards of skill, experience, and capability which is taking place throughout American business, and is specially emphasized in periods of depression and rising costs. In a broad sense this process is a form of "technological unemployment," but little or nothing is known about it, and it is not considered in this study. It is probably a significant factor in the current unemployment problem, but without wider and more definite knowledge than is now available it is impossible to understand its relation to mechanization. It is clear, however, that greater attention needs to be given to methods, private and governmental, of education and rehabilitation in order to raise the level of productive competence of young and older workers in all occupations; and the Conference Board is planning to undertake studies in this field.


Under whatever type of economic or political system, and regardless of governmental provisions for unemployment protection, little progress will be made in dealing with the unemployment problem until the realities of this question are frankly faced and intelligently met. The increasing use of machinery to enlarge productivity is inescapable and irre-

pressible in any progressive society, and attacks upon it are mistaken, misleading and futile. Education and the development of human capacities are the essential problems of social progress.

With an increasingly severe shortage of skilled labor already evident in the early stages of recovery from business depression, while millions of our potential working population are idle, and many more millions of our whole population depending upon government support, wise and sincere statesmen in both industry and public office will rather look forward to the future when, with a stationary or declining population, we shall have to consider how the mechanization of industry and trade may be speeded, workers trained and adapted to new occupations and greater productiveness, and our people inspired and encouraged to new enterprise in order that the rise in the standard of life may be sustained.

VIRGIL JORDAN
President

New York City
May, 1936



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MACHINERY, EMPLOYMENT, AND PURCHASING POWER

CHAPTER I

MACHINERY AND UNEMPLOYMENT

MACHINERY was invented and is used extensively in order to reduce the amount of labor necessary to produce a given amount of goods and services. There are three ways in which that result might occur. (1) Machines could wholly replace the labor of a portion of the working population and leave them permanently without employment, still enabling as much or more to be produced. In this case, the introduction of machinery would mean that the number of unemployed, and the percentage of unemployed persons in the total able and desiring to work, would increase and that this unemployed group would have to be supported out of the production of the rest. (2) The use of machinery might reduce the total amount of working time needed for production, without decreasing the number or proportion of people working. (3) The amount produced by the use of machinery might be so increased that the cost would be reduced, and consumption thereby so expanded that the same number of persons might be employed the same length of time.

The first of these consequences is commonly supposed to have resulted from the rapid introduction of machinery. This chapter examines that supposition on the basis of the available evidence of the extent to which the number and proportion of unemployed among the working population has changed during the period of rapid mechanization. To

understand the significance of this evidence it is first necessary to define the nature and kinds of unemployment and to describe the character of the evidence bearing upon its extent and causes.

NATURE AND CAUSES OF UNEMPLOYMENT

In respect to the problem of employment and unemployment the population at any time consists of five groups:

(a) Those who have never worked at a gainful occupation and are not seeking work. This group includes children too young to work or below legal working age, children and adults who have always been and are being supported by others or out of their own means.

(b) Those who are working at a gainful occupation, for themselves or for an employer.

(c) Those who may have worked at a gainful occupation but are not now working or seeking work. This group includes vagabonds, criminals at large, persons permanently or temporarily unemployed or unemployable because of physical, mental, or moral defects, persons in penal and correctional institutions, and other persons who have secured means of support from public or private sources without working.

(d) Those who have never worked at a gainful occupation, and are not now working, but are seeking work. This group includes young persons coming out of school or reaching working age and seeking first employment; and adults who have lost their previous means of support or for other reasons wish to find gainful employment.

(e) Persons who have worked at a gainful occupation, and are not now working, but are in the market for employment.

As referred to hereafter in this study, the "gainfully occupied" population includes all persons who usually follow a gainful occupation, and relates to the second, third, and fifth groups. The problem of "relief" relates to the last

three groups and is a social or public problem rather than one of industry. Strictly considered, the problem of unemployment at any time relates only to the last two of these groups. For purposes of closer analysis these last two groups together may be divided into the following classes:

- (1) Persons not working because of labor disputes.
- (2) Inefficient or inadequately trained or experienced workers whom employers can not profitably employ at any wage, or at the established or prevailing wage, or at the wage which they demand.
- (3) Employable young persons and adults seeking first employment in any occupation at any wage.
- (4) Employable persons who have temporarily lost their jobs because of seasonal slackness in their occupation in their locality.
- (5) Employable persons temporarily unemployed for short periods while moving from one job to another in the same plant or locality because of ordinary interruptions in work for other than seasonal reasons.
- (6) Employable persons who are out of work because of general business depression.
- (7) Employable persons who have lost their jobs because of changes in the industry in which they have been employed, due to technological improvements, shifts in market demand for products, shifts in sources of materials, or relocation of plants, and who are unable or unwilling to change their occupation or to move to another locality.

When the nature, forms, and factors of unemployment are defined in this way, it appears that the increased use of machinery could conceivably affect employment in four ways: (1) directly, by adding to the seventh class mentioned; (2) indirectly, by contributing to general business depression, thus increasing the sixth class of unemployed; (3) directly, by so increasing production as to enable the less efficient or productive workers to be employed at prevailing or required

wages, thus diminishing the second class listed; and (4) directly, by leading to labor disputes arising from introduction of new machinery.

In view of these possibilities two questions arise. What does the available information about the unemployed show regarding the extent to which the first two effects may have resulted from the increased use of machinery? What does the available information about the relative growth of the gainfully occupied population and the total population indicate regarding the relation of machinery to the total opportunities for employment? The latter general question will be considered in succeeding chapters. In the remainder of this chapter the available evidence regarding the first question is analyzed.

STATISTICAL DATA ON UNEMPLOYMENT

Except for the Federal Unemployment Census of 1930, no definite and comprehensive statistical information regarding unemployment in the United States is available. Federal Government agencies since that time have collected a large amount of data regarding the unemployed population who have been receiving public aid, but this has little bearing on the problem of unemployment. The only direct information regarding unemployment, either prior or subsequent to, 1930, relates to certain states and specific localities.

The unemployment census of 1930, taken in connection with the regular decennial federal census, was the first nation-wide count of the unemployed. It is in many respects seriously inadequate as a measure of the extent and causes of unemployment, because of the vagueness of classifications used and because it relates only to conditions on a specific day; but it is the only comprehensive record available. Prior to it, a few sample unemployment surveys in specific localities were conducted, the first of which was made by the Metropolitan Life Insurance Company and the United States

Bureau of Labor Statistics in an investigation of conditions in New York City during the first part of 1915. These studies were immediately followed by a second series of investigations conducted by the Metropolitan covering sixteen Eastern and Middle Western cities. During June and July, 1915, the same organization made a survey of unemployment in twelve Rocky Mountain and Pacific Coast cities. From 1915 to 1930 additional surveys were made, but they covered only five cities, New York City, Columbus, Baltimore, Buffalo, and Philadelphia. These surveys are limited in scope and were made in different and non-consecutive years. They are, therefore, inadequate to give an accurate and comprehensive picture of the unemployment situation in the United States over a period of years.

In view of the inadequacy of direct evidence, it is necessary to use estimates based on fluctuations in the volume of employment in order to arrive at a measure of the extent of unemployment.

Estimates of Volume of Unemployment

A series of unemployment estimates from 1897 to 1926, prepared by Professor Paul H. Douglas,¹ is shown in Table 1.

Throughout this thirty-year period, according to these estimates, the rate of unemployment in the labor force in manufacturing, transportation, building trades, and mining industries averaged 10.2%, ranging from a low of 5.5% in 1918 to a high of 23.1% in 1921. In the first decade of this period, 1897-1906, unemployment averaged 9.9%; in the second decade, 1907-1916, the average was 10.2%; and in the last decade, 1917-1926, it was 10.3%.

These figures cannot be taken as a measure of unemployment in all industries because they cover only industrial groups which are particularly susceptible to fluctuations in business activity. That these rates tend to overstate the

¹ Paul H. Douglas, "Real Wages in the United States, 1890-1926," Houghton Mifflin Company, Boston, 1930.

TABLE 1: PERCENTAGE OF UNEMPLOYED AMONG THE LABOR FORCE IN MANUFACTURING, TRANSPORTATION, BUILDING TRADES, AND MINING INDUSTRIES, 1897 TO 1926

Source: Paul H. Douglas, "Real Wages in the United States, 1890-1926"

Year	Percentage Unemployed	Year	Percentage Unemployed
1897	18.0	1912	7.0
1898	16.9	1913	8.2
1899	10.5	1914	16.4
1900	10.0	1915	15.5
1901	7.5	1916	6.3
1902	6.8	1917	6.0
1903	7.0	1918	5.5
1904	10.1	1919	6.9
1905	6.7	1920	7.2
1906	5.9	1921	23.1
1907	6.9	1922	18.3
1908	16.4	1923	7.9
1909	8.9	1924	12.0
1910	7.2	1925	8.9
1911	9.4	1926	7.5

actual ratio of unemployment is indicated by a comparison of Professor Douglas' estimates with those prepared for all non-agricultural industries for the period 1920 to 1926 by Meredith Givens and Leo Wolman, members of a special staff of the National Bureau of Economic Research,¹ shown in Table 2. The lower unemployment rate estimated in the

TABLE 2: PERCENTAGE OF UNEMPLOYED IN NON-AGRICULTURAL OCCUPATIONS, 1920 TO 1926

Source: Meredith Givens and Leo Wolman, "Recent Economic Changes," National Bureau of Economic Research, New York, 1929

Year	Manufacturing	Construction	Transportation and Communication	Mines, Quarries, and Oil Wells	Public Service, Mercantile and Miscellaneous	Five Groups Combined
1920	4.4	24.7	4.0	22.5	2.4	5.1
1921	23.7	26.6	14.4	38.1	3.7	15.3
1922	16.4	19.2	13.1	41.6	3.2	12.1
1923	4.0	17.2	5.4	26.2	2.6	5.2
1924	8.8	25.9	7.3	27.3	3.0	7.7
1925	5.5	21.4	4.0	26.1	2.8	5.7
1926	5.2	17.6	3.0	25.3	2.7	5.2

¹ "Recent Economic Changes in the United States." Report of the Committee on Recent Economic Changes of the President's Conference on Unemployment, including the reports of a Special Staff of the National Bureau of Economic Research." McGraw-Hill Book Company, New York, 1929.

National Bureau's study can be attributed to the greater stability of employment in trade and service industries and in government service, included in these estimates but not in those of Professor Douglas. The steady increase in the proportion of workers engaged in these groups of occupations, which will be shown later, has exerted a stabilizing influence on non-agricultural employment as a whole.¹

Since 1930, estimates of total unemployment have been issued periodically by the American Federation of Labor, by Colonel Leonard P. Ayres of the Cleveland Trust Company, by Mr. Robert R. Nathan, Chief of the Income Section of the Bureau of Foreign and Domestic Commerce, and by the National Industrial Conference Board. These estimates have indicated a large increase in the volume of unemployment during the depression. The high point was reached in March, 1933, when between 13,537 million and 16,119 million persons were estimated to be out of work.

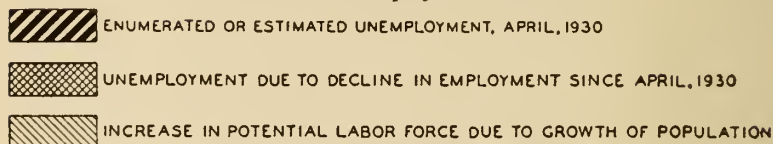
The lack of agreement among these estimates, as shown in Chart 1, illustrates the difficulties surrounding any attempt to determine the extent of the increase or decrease in the number of unemployed persons. All of these estimates have used the Unemployment Census of 1930 as the basis or starting point. Data on the "Trend of Employment," issued by the United States Bureau of Labor Statistics, have constituted in each case the chief measure of the changes that have taken place since that enumeration. Each estimate makes allowance for the effect of an increase in population. In spite of these common characteristics, however, the estimates have differed radically as a result of differences in the use and interpretation of data.

Although all of the estimates have been derived basically from the figures obtained in the census enumeration, differences arose at the outset through lack of agreement in regard to the definition of unemployment. Colonel Ayres and the Conference Board included only groups A and B as classified

¹See Chapter II of this volume.

CHART 1: FOUR UNEMPLOYMENT ESTIMATES, UNITED STATES, OCTOBER, 1935

Number of Unemployed in Millions



by the census.¹ The estimates of Mr. Nathan and the American Federation of Labor included, in addition, part of the persons enumerated in the other census classifications. A further enlargement of the figures in these latter estimates results from an adjustment of the census data on the assumption that there was an under-enumeration of the unemployed by the census.² The effect of these differences is as follows:

	Unemployed April, 1930
American Federation of Labor.....	4,048,682
Mr. Robert R. Nathan.....	4,386,000
Colonel Leonard P. Ayres.....	3,188,000
National Industrial Conference Board.....	3,188,000

¹ The various census classifications are shown on p. 12.

² The adjustment is based upon the results of a special enumeration conducted by the Bureau of the Census in January, 1931, and covering only nineteen cities.

The various estimates have also been affected to some degree by differences in the method of determining the amount of increase or decrease resulting from changes in business activities. The indexes applied in each case have not been identical, and the procedure employed in relation to those fields not covered by satisfactory indexes has varied. These differences in statistical details have resulted in considerable variation in the estimates for particular groups, but those variations have tended to offset one another in the totals, except in the case of the estimate of Colonel Ayres, which has shown a substantially higher figure than the other estimates.

Differences in the method of determining the number of new workers, resulting from the increase in population, have also been responsible for differences in the totals. Mr. Nathan and the Conference Board have computed this increase by applying the ratio of gainful workers to total population in 1930 to estimates of total population for subsequent months. Colonel Ayres and the American Federation of Labor have obtained much higher estimates by utilizing figures developed by the Scripps Foundation for Population Research, which would seem to indicate that persons over fifteen years of age now constitute a larger proportion of the population than in 1930.

These estimates are the only indications available regarding the aggregate number and relative proportion of persons unemployed. Except for the data gathered in the Unemployment Census of 1930, for a single day, they are estimates produced by processes of statistical construction. It must remain uncertain how closely they measure the amount of involuntary unemployment at any time. At most all that can be said is that they provide for certain periods a rough measure of the size of a group of the population who are not working but who are available for work or might be expected to be working. They throw little light on the characteristics and circumstances of the persons not working or on the causes of their unemployment. So far as they go they indi-

cate only that, except during periods of business depression, there appears to have been no clear tendency for the proportionate size of this group to increase during a period of rapid mechanization of industry.

Amount of Time Lost

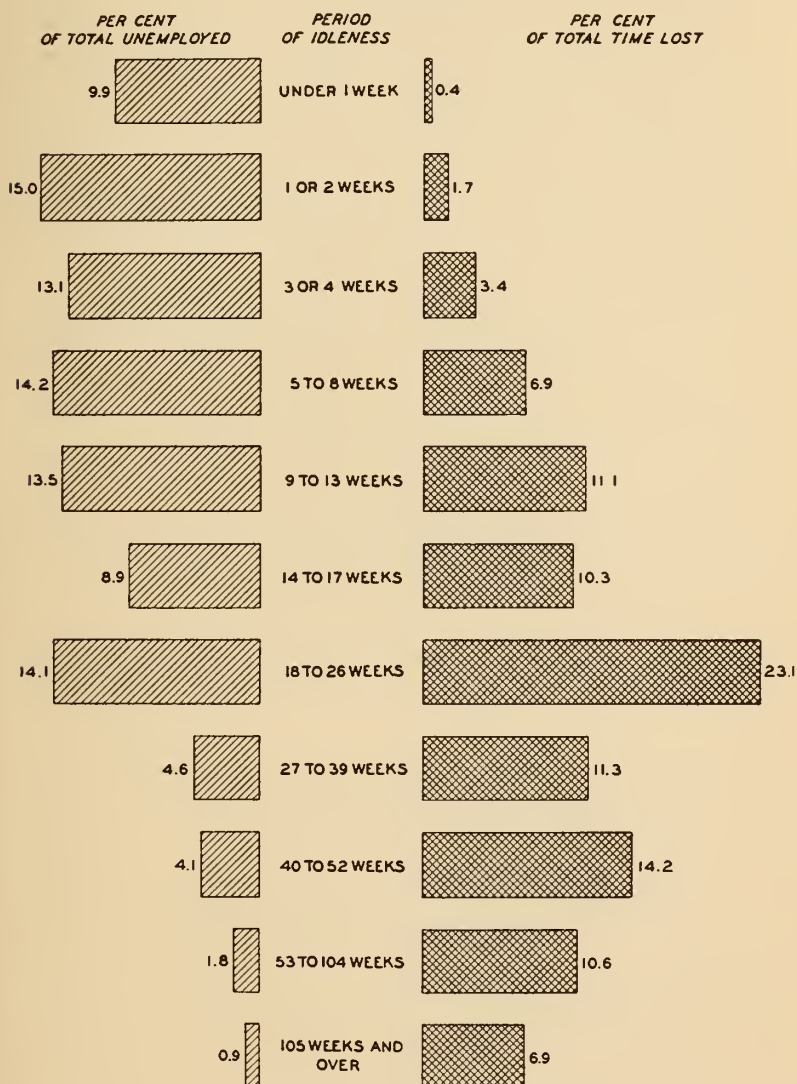
All of the various attempts to determine the number of unemployed persons portray only the situation existing at a particular time. It must not, however, be assumed that all of the persons counted as "unemployed" in these enumerations or estimates remain permanently unemployed; in fact, except in extended periods of depression, unemployment in the case of persons able and willing to work is usually of a short-term character.

The amount of long-term unemployment in periods of relative prosperity is very small. People are out of work a few weeks, or in extreme cases a few months. On the other hand, in periods of acute depression, the amount of long-term unemployment is greatly increased by the prevailing shortage in employment opportunities. The extensive relief measures inaugurated in such periods also tend to increase the volume of permanent unemployment. The less self respecting prefer the short rations of direct relief, or the half-idleness of work relief, to hard work in a regular job. The willing worker hesitates to accept any job which he is not sure will be permanent, as by so doing he gives up his relief status. The recovery of that status, if the job proves to be temporary, is likely to involve delay and a profusion of red tape.

Some idea of the volume of unemployment in terms of time lost as compared with the number of persons out of work at the date of the 1930 enumeration may be obtained from the percentages shown in Chart 2. The percentages of time lost up to the date when the census was taken are based on the periods of idleness as reported by the unemployed in Classes A and B.¹ In analyzing these data it should

¹ See page 12.

CHART 2: CLASSES A AND B IN CENSUS OF 1930, PER-
CENTAGE OF TOTAL NUMBER UNEMPLOYED AND OF
TOTAL TIME LOST FOR VARIOUS PERIODS
OF IDLENESS



be borne in mind that at the time this census was taken the effect of the decline in business activity upon employment was only beginning to be felt.

The group idle from one to two weeks was the largest in number of persons, but it accounted for less than two per cent of the total time lost. The group "5 to 8 weeks" was next in order of number unemployed, with less than 7% of the total idle time. The group "18 to 26 weeks" accounted for over 23% of the time lost, although the number involved was only 14.1% of the total unemployed. The group out of work from one to two years constituted less than 2% of the unemployment total. Over half of the unemployed workers had been idle less than two months, and two-thirds less than three months. The total unemployed in Classes A and B was 3,102,122¹ and the total time lost approximately 41,459,000 weeks, or an average of 13.4 weeks.

Relative Importance of Causes of Unemployment

If the data for the calculation of volume of unemployment are inadequate, those which must be depended upon for an analysis of the causes of unemployment are still more so. This is true even of the 1930 census, which gathered data relating to causes of unemployment in considerable detail. The number of persons in each of the various classifications used in that census were as follows:

Class A—Persons out of a job, able to work and looking for a job.....	2,429,062
Class B—Persons having jobs but on lay-off without pay, excluding those sick or voluntarily idle.....	758,585
Class C—Persons out of a job and unable to work.....	172,661
Class D—Persons having jobs but idle on account of sickness or disability.....	273,588
Class E—Persons out of a job and not looking for work....	87,988
Class F—Persons having jobs but voluntarily idle, without pay.....	84,595
Class G—Persons having jobs and drawing pay, though not at work (on vacation, etc.).....	82,335
Total gainful workers not at work.....	<u>3,888,814</u>

¹ Excludes those whose periods of idleness were not reported.

In this list the most numerous classes, A and B, obviously belonged among the unemployed under any definition of that term. The distinctions between the various classes are indicated in the following explanatory paragraphs from the census report:

"Class B includes many persons who are working on part time, and are therefore better situated than those who have no jobs at all. The question as to whether a man has a job or not has proved to be a difficult one to answer, and class B includes many persons who have been laid off from their jobs for long periods . . . some of whom are practically in the same position as those in class A. Nominally, they have a job, but practically they are not receiving any income from that job, and they may have no definite promise as to when that income will be resumed.

"Classes C and D are made up of persons unable to work. Their separation from their job is a matter of personal misfortune rather than the result of scarcity of employment.

"Classes E, F, and G are made up for the most part of persons whose idleness is voluntary, and who were included in the unemployment count as an incidental result of the method of selection used. Class E is composed of persons able to work and having no job, who were reported by the enumerator as not looking for work. Class F is made up of persons having jobs and not drawing pay, for whom the reason for idleness was reported to be 'voluntary lay-off' or its equivalent. Class G includes all those having jobs who were reported by the enumerator as not losing pay as a result of their idleness, being mainly persons on vacation with pay.

"According to the returns on which the classifications were based, the persons in these three classes have little in common with the truly unemployed."¹

The census of 1930 classifies causes of unemployment under fifteen general heads. The data for each of these, with the detailed causes under each head, are shown in Table 3.

In evaluating the relative importance of the various causes of unemployment, it becomes apparent at once that they fall into two classes: (1) Those which have an approximately constant influence and are not materially affected by depres-

¹ United States Bureau of the Census, "Fifteenth Census of the United States: 1930, Unemployment," Washington, D. C., 1931, Vol. I, p. 7.

TABLE 3: CAUSES OF UNEMPLOYMENT, UNITED STATES,
APRIL, 1930

Source: United States Bureau of the Census

Class	Reasons for Idleness	Unemployed		
		Number	Per 1000 Gainfully Occupied	Per 1000 Un- employed
A and B	Immediate or superficial reasons			
	Laid off.....	734,987	15	202
	Other immediate reasons....	452,120	9	124
	Total.....	1,187,107	24	327
A and B	Economic conditions			
	Job complete.....	425,384	9	117
	Plant closed.....	314,477	6	87
	Lack of orders.....	134,256	3	37
	Part time workers.....	78,115	2	21
	Shortage of material.....	37,528	1	10
	Substitute workers.....	7,671	1	2
	Other economic conditions..	8,049	1	2
	Total.....	1,005,480	21	277
A and B	Seasonality			
	Off season.....	370,245	8	102
	Other seasonality.....	114,182	2	31
	Total.....	484,427	10	133
D	Persons having jobs but idle on account of sickness or disability	273,588	6	75
C	Persons out of a job and unable to work.....	172,661	4	48
A	Personal disability.....	138,273	3	38
A and B	Industrial policy			
	Reduction of force.....	71,365	1	20
	Machines introduced.....	10,651	1	3
	Worker too old.....	8,051	1	2
	Cheaper labor substituted..	776	1	1
	Other reasons of industrial policy.....	22,730	1	6
	Total.....	113,573	2	31
A and B	Dissatisfaction.....	101,715	2	28
A	Voluntary absence			
	Voluntary lay off.....	35,502	1	10
	Other voluntary absence....	7,372	1	2
	Total.....	42,874	1	12
A and B	Weather conditions.....	31,979	1	9
A and B	Family reasons.....	29,347	1	8
A and B	Labor disputes.....	15,305	1	4
A and B	Breakdown of plant or equipment	13,184	1	4
A and B	Miscellaneous.....	6,505	1	2
A and B	Reasons not reported.....	17,878	1	5
	Grand Total.....	3,633,896	74	1,000

¹ Less than 0.5 per thousand.

sion or prosperity; and (2) those directly related to cyclical fluctuations in business activity. In the first class are sickness, old age, other personal disabilities, and seasonality. Changes in industrial policy not attributable to business depression also belong in this group. It is in connection with such changes that unemployment directly due to technological advances must be sought.

It is significant, in view of the claim that extensive unemployment has been caused by the introduction of labor-saving machinery, that in the census of 1930 the number of workers who attributed their unemployment to this cause is so small. In a total of 3,633,896 returns reporting unemployment in that census, only 10,651 persons, or less than one-third of one per cent, gave "Machines introduced" as the reason for being out of work. It is safe to assume that the installation of this type of machinery does not take place without the knowledge of the worker whose means of gaining a livelihood is threatened by it. The answers given by the persons enumerated in a census are often vague and misleading. The questions may not be understood. In the case of the census of 1930 the questions relating to unemployment were probably found to be particularly confusing in the numerous instances where more than one reason could be given for being out of work. But considering the general attitude of workers towards the introduction of labor-saving machinery, the number who attributed their unemployment to this cause is likely to represent too large, rather than too small, a proportion of the unemployed.

In addition to the census of 1930 certain other data in relation to the causes of unemployment are available in a few sample surveys in specific localities. Such a survey, covering sixteen Eastern and Middle Western cities, was made by the Metropolitan Life Insurance Company in cooperation with the United States Bureau of Labor Statistics in March and April, 1915. Another, covering twelve Rocky Mountain and

Pacific Coast cities, was made under the same auspices in June and July of that year. Two similar joint surveys dealing with unemployment conditions in New York City were made in February and September, 1915, but data on causes of unemployment were tabulated only in the latter of these investigations. Sample surveys were also conducted in Columbus, Ohio, during the period 1921 to 1925, by the local unemployment committee in cooperation with members of the teaching staff of Ohio State University. The New York State Department of Labor, assisted by The Buffalo Foundation, likewise surveyed conditions in Buffalo, New York, in 1929, 1930, and 1931. The data collected in these sample surveys are presented in Table 4.

It is hardly to be expected that the relative importance of the various causes of unemployment as shown in these sample surveys would coincide with the results of the country-wide census. The Columbus and Buffalo studies were limited in scope, covering only a small proportion of the unemployed in those cities during the depression years included in those surveys. The proportion of cases classified as to cause under "Sickness and Disability" and "Old Age and Retirement" greatly exceeds in most instances the corresponding percentages in the census of 1930 and those of the sample surveys made in 1915. The proportion in the 1930 census for all causes that might be grouped under these two heads is about 16% of the total unemployed. This corresponds fairly closely with the percentages shown in the Buffalo survey for the same year.

With respect to these data on the causes of unemployment it should be noted that the relationship between the number out of work for a specific cause and the total body of unemployed has little significance, as the volume of unemployment tends to rise during depressions and fall in times of prosperity, with a resulting decrease and increase in the ratios. The importance of any of these relatively constant factors might

TABLE 4: UNEMPLOYMENT ATTRIBUTED TO SPECIFIC CAUSES IN VARIOUS UNEMPLOYMENT SURVEYS

Sources: United States Bureau of Labor Statistics and New York State Department of Labor

Unemployment Survey	Number of Cases	Causes				
		Lack of Work	Sickness and Disability	Old Age or Retirement	Strikes and Lockouts	Miscellaneous
16 Eastern and Middle Western Cities, March and April, 1915.....	68,084	56,274	7,475	..	328	4,007
12 Rocky Mountain and Pacific Coast Cities, June and July, 1915....	5,830	4,544	662	..	100	524
New York City, September, 1915.....	6,256	4,874	946	..	65	371
Columbus, Ohio						
1921.....	1,404	1,079	202	120	..	3
1922.....	845	238	288	155	153	11
1923.....	754	282	255	177	3	37
1924.....	904	491	218	144	2	49
1925.....	954	403	297	205	..	49
Buffalo, New York						
1929, November.....	1,493	821	319	254	..	99
1930, November.....	2,780	2,254	248	260	..	18
1931, November.....	4,145	3,560	256	318	..	11
Percentage Distribution						
16 Eastern and Middle Western Cities, March and April, 1915.....	100.0	82.6	11.0	..	0.5	5.9
12 Rocky Mountain and Pacific Coast Cities, June and July, 1915....	100.0	77.9	11.4	..	1.7	9.0
New York City, September, 1915.....	100.0	77.9	15.1	..	1.0	6.0
Columbus, Ohio						
1921.....	100.0	76.9	14.4	8.5	..	0.2
1922.....	100.0	28.2	34.1	18.3	18.1	1.3
1923.....	100.0	37.4	33.8	23.5	0.4	4.9
1924.....	100.0	54.3	24.1	15.9	0.2	5.4
1925.....	100.0	42.2	31.1	21.5	..	5.1
Buffalo, New York						
1919.....	100.0	55.0	21.4	17.0	..	6.6
1930.....	100.0	81.1	8.9	9.4	..	0.6
1931.....	100.0	85.9	6.2	7.7	..	0.3

more properly be measured on the basis of a comparison with the total labor force. In the census of 1930 the number of workers who gave sickness and other types of personal disability as the reason for idleness represented about 1.2% of the total gainfully occupied.

SEASONAL UNEMPLOYMENT

Lack of work is caused primarily by cyclical or seasonal fluctuations in business activity. Seasonal fluctuations occur as a result of such factors as concentration of demand and production in certain seasons of the year. Unemployment due to these influences is known as seasonal unemployment.¹ The seasonal indexes of employment of the Federal Reserve Board show that fluctuations are the highest in the canning and preserving industry, with a high point of 227 and a low of 48 during the year, compared with an average of 100. Employment is most stable in the printing, newspaper, and periodicals industry, remaining close to the average of 100 throughout the year.

Seasonal layoffs occur at different times of the year in different industries. Some of the workers laid off in an industry at the time of lowest activity are able to find work in some other industry which at that time may be operating at maximum capacity.

Chart 3 shows the seasonal patterns of two industries, both of which are in the rubber field: the rubber boot and shoe industry and the tire and tube industry. From March through August the boot and shoe industry reaches the low point of seasonal activity, while during the same period the activity in the tire and tube industry rises to its peak. Under these conditions it is possible that workers employed by one industry may during dull periods find employment in the other industry.

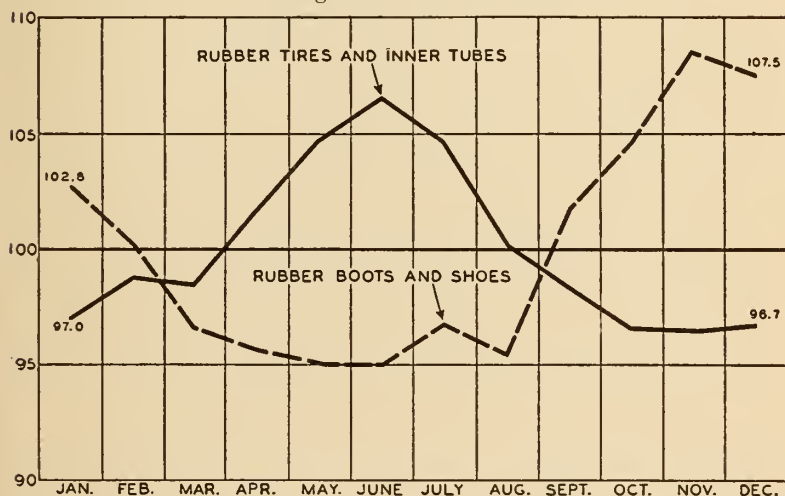
The ability of the workers, however, to shift from one occupation to another during seasonal slackness is limited, first, by the fact that highly skilled workers in one occupation may be unable to meet the technical requirements in some other field of work and, second, by the fact that workers cannot easily move from one place to another or from one

¹ Various methods of employment stabilization have been adopted in industries affected by seasonal factors. See: National Industrial Conference Board, "Lay-off and Its Prevention," New York, 1930.

region of the country to some other region in search of work. In the building industry, for example, the low point of seasonal activity in the North is reached during the winter months, while the Southern industry is working at its peak. The workers, however, cannot readily move from region to region in order to take advantage of this situation.

CHART 3: INDEX NUMBERS OF SEASONAL VARIATIONS IN EMPLOYMENT IN TWO INDUSTRIES

Average for the Year = 100



The difficulties involved in ascertaining the true volume of unemployment due to seasonal causes are very great. It is highly probable that a large number of the workers who in the census of 1930 gave "Job completed" and "Laid-off" as the reason for idleness¹ were customarily engaged in occupations in which the work was of an intermittent character. The census figure for seasonality is made up of "Off season," 370,245, and "Other seasonality," 114,182, to which "Weather conditions," 31,979, might be added, making a total of 516,406. It is likely that this figure is too low. Kuznets, in

¹ See Table 3, page 14.

his comprehensive study, "Seasonal Variations in Industry and Trade," estimates the measure of excess labor supply attributable to seasonal factors at 3% for manufacturing, 15% for construction, and 5% for total trade. Applying these ratios to King's estimate of the number of wage earners attached to those groups in 1927, Kuznets obtained a rough estimate of about 700,000 seasonally unemployed persons in the three fields of economic activity. Extending the estimate to include agriculture, transportation, and mining, he reached the conclusion that, while the seasonal surplus of labor would vary from month to month, "about one million would be the average volume of seasonal unemployment persisting from year to year."¹

DEPRESSIONAL UNEMPLOYMENT

Unemployment becomes a grave social and economic problem only in periods of business depression. The solution of the problem, therefore, lies in discovering and eliminating the cause or causes of business depressions. To what extent are the introduction of machinery and technological improvements responsible for booms and depressions?

The question of business fluctuations first attracted the attention of economists and students of economic problems early in the nineteenth century. Since that time an immense volume of literature has been produced on this subject. An excellent summary of this literature is given in Professor Wesley C. Mitchell's book on "Business Cycles,"² in which he lists the following factors to which a major role in causing fluctuations has been assigned by competent students in modern times:

1. Changes in sun-spots which affect the weather, the yield of crops, and, therefore, prices.

¹ Simon Kuznets, "Seasonal Variations in Industry and Trade," National Bureau of Economic Research, New York, 1933, pp. 353-54.

² Wesley C. Mitchell, "Business Cycles," National Bureau of Economic Research, New York, 1927, pp. 11-57.

2. The uncertainty which characterizes all business plans concerning the future.

3. The emotional aberrations which affect all business activities and which create errors of optimism and errors of pessimism.

4. Innovations, characteristic of modern society, which disturb the economic equilibrium and lead to crises, readjustments, and new booms.

5. Oversaving and overinvestment which arise from the fact that a large portion of the wealth belongs to a small proportion of the people who cannot spend their incomes and who are, therefore, forced to save and invest the surplus. During the years of prosperity this process of saving and investment increases the quantity of goods and services available to the people, but it also increases those incomes from which savings are made. This cumulative process of saving finally leads to a market glutted with goods, with the result that prices break, production declines, bankruptcies and reorganizations scale down the capital structure, the incomes of the wealthy are drastically reduced, savings disappear almost entirely, leading to a gradual elimination of accumulated stocks of goods and to new investments and prosperity.

6. Overproduction of industrial equipment and overexpansion of construction which destroy the balance between non-durable and durable goods and lead to booms and depressions.

7. Generalized overproduction, caused by overproduction of industrial equipment during periods of prosperity, which leads to a fall in prices, because in order to pay for itself the equipment must be kept running.

8. The operation of the banking system which leads to overexpansion of bank credit, low interest rates, competitive bidding for raw materials and capital equipment, increase in prices, and finally, depletion of bank reserves, contraction of credit, and a decline in the volume of business.

9. The uneven flow of money incomes which makes it impossible for the people to buy at profitable prices all that they produce.

10. The conduct of business for profits which leads business men, in anticipation of higher profits, to overdevelop certain lines of activity, thus creating excessive prices, overcapitalization, overexpansion of credit, excessive costs, and finally, liquidation, and depression.

“Each of these explanations,” Professor Mitchell points out, “merits attention from those who seek to understand business cycles; for each should throw some light upon some feature or aspect of these complex phenomena.”¹

All these theories are grouped by Professor Mitchell under three main headings: (1) Theories which trace business fluctuations to physical processes; (2) those which ascribe business cycles to emotional processes; and (3) theories which attribute business ups and downs to institutional processes. The factors alleged to be responsible for business cycles in the various theories under the third heading include the application of scientific inventions, introduction of new products, developments of new types of industrial and commercial organizations, fluctuations in profits, failure of consumer incomes to keep pace with money value of goods produced, lack of equilibrium in the production and consumption of goods in general, oversaving and overinvestment in capital goods, and overlending by the banks.

It is apparent from these explanations of business fluctuations, each of which concerns a part of the problem, that introduction of machinery and technological improvements cannot be reasonably regarded as the sole or primary cause of depressional unemployment. As stated by Professor Mitchell, “Everyone who has studied economics realizes that business activity depends upon the smoothly coordinated functioning of many processes, the extraction or grow-

¹ *Ibid.*, p. 12.

ing of raw materials; the fabricating, distributing, transporting, and consuming of goods; the payment and spending of money incomes; the saving and investing of capital; the granting and cancelling of credits. Any of these factors or any of these processes can be made to yield a plausible theory of business cycles, provided some investigator can show that it is an independent source of recurrent fluctuations in the activity of trade. And that is what each of our theorists believes himself to have done with reference to the factor of his choice."¹

Although economists are not in agreement regarding the cause of the business cycle, popular opinion seems to accept the theory that depressions are the result of the accumulation of capital goods during prosperous years at a rate substantially higher than that of the increase in consumption. As a result, it is contended, production and consumption are thrown out of balance, causing severe maladjustments in the entire national economy. To avoid these maladjustments, therefore, it is proposed to control the production of capital goods, including machinery and mechanical equipment.

Investigation furnishes no evidence to support this theory. A study by the Conference Board shows that from 1919 to 1929 the dollar value of consumers' goods fluctuated between 75% and 80% of the total value of production of all goods, excluding construction.² After the depression of 1921 and up to the year 1929 the proportion of consumers' goods in the total value of output fluctuated only between 76% and 78%, while the value of producers' goods varied only between 22% and 24% of the total. Throughout the entire period the dollar value of consumers' goods remained constantly a little more than three times as large as the dollar value of producers' goods.

¹ *Ibid.*, p. 48.

² National Industrial Conference Board, "Dollar Values of Production of Goods and Construction, 1914-1933," New York, 1934.

Another study covering the years 1919-1929 yields essentially the same results.¹ With the exception of the years 1924 and 1927, the movement of consumers' goods went hand in hand with that of producers' goods, expanding and contracting simultaneously.

These two studies indicate that it is extremely doubtful that the depression was caused by the excessive production of capital goods in relation to consumers' goods. Evidently, the capital goods industries were producing no more than the consumers' goods industries could absorb or were demanding for the performance of their business on the most efficient basis. In other words, there was no noticeable overproduction of capital goods or consumers' goods.

During the pre-depression years goods were being absorbed as quickly as they were being produced. Unemployment did not grow out of overproduction of, or by, machines. Workers were laid off, beginning at the end of 1929, because business in general had begun to wane. The more the volume of business declined, the more workers became unemployed, thus causing an additional shrinkage in business. Capital goods industries, especially those making machines or engaged in the field of construction, suffered the greatest loss of business, not as a result of over-mechanization of industry, but because they were producing goods the purchase of which could, on the whole, be deferred until better business warranted or made possible the renovation and modernization of old plants or building of new plants.

SUMMARY

Factual information concerning unemployment, its extent, duration, and causes, is practically non-existent for the United States over any length of time. The only comprehensive survey of unemployment is the Federal Unemployment

¹ Harold G. Moulton, "The Formation of Capital," Brookings Institution, Washington, D. C., 1935.

Census of 1930. That census, however, refers to only one day in the year 1930, and in addition, its usefulness is limited by the vagueness of the classifications employed and the instructions given to the enumerators. Additional fragmentary data regarding unemployment are available in sample unemployment surveys conducted in various parts of the country. This information leads to the following general conclusions.

In years of normal business activity the bulk of unemployment is due to old age, sickness, injury, strikes, and seasonal fluctuations in business. Unemployment also arises out of the fact that at any given time there are a certain number of workers who have voluntarily left their employment to seek other work. Any enumeration of the unemployed likewise includes persons who have ceased working for various reasons not related to business activity. In this latter group are those workers who find themselves without employment because their employer has reduced the number of workers by means of machinery and technological improvements.

A certain amount of technological unemployment unquestionably exists at all times. Its volume cannot be estimated, but it is significant that in the Unemployment Census of 1930 less than one-third of one per cent of the persons reported as unemployed attributed their unemployment to the introduction of machinery.

There is no evidence to support the theory that machinery is a major cause of business depressions and the resulting increase in unemployment. The variety of explanations of the business cycle offered by economists indicates that no single factor should be held responsible. Furthermore, recent studies show that there was no apparent overproduction of capital goods in the period from 1919 to 1929.

CHAPTER II

EMPLOYMENT AND PRODUCTION

THE available statistical information concerning the extent and factors of unemployment, reviewed in the preceding chapter, gives no evidence that during the period of its most rapid development, growth of industrial mechanization has tended to cause a general increase in the fraction of the working population who can not secure employment. Rather, the evidence indicates instead that the introduction of machinery could not have been an important factor in such involuntary unemployment as has existed.

This conclusion leads to a more general question in the investigation of the relation of machinery to employment. Even if there is no evidence that the fraction of the working population that is unemployed has increased relatively for reasons that can be ascribed to the introduction of machinery, has the working population—those who are classed as gainfully occupied—increased in proportion to the whole population? If the proportion of the total population which is normally gainfully occupied, even though some may not be working at a given time, has declined, there may be some basis for the belief that the use of machinery has tended permanently to reduce the number of persons required to produce the total goods and services provided for the population. The only conceivable alternatives to this conclusion would be (a) that the amount of time spent in work by the working population has increased or (b) that the volume of goods and services provided for the total population has not increased in proportion to the increase of the whole population, or has decreased relatively to the population.

If, on the other hand, it appears that the volume of production has increased as much as or more than the population, and that the total working time has decreased, while the proportion of gainfully occupied in the total population has increased, it would be clear that the use of machinery has not reduced the total volume of gainful employment.

The factors concerning which the available evidence must be considered in an analysis of this question are: (1) the growth of the gainfully occupied population in comparison with the total population; (2) the growth of the volume of production; (3) the changes in working hours of the working population.

WORKING POPULATION

The change in the economic structure of the United States from an agricultural and handicraft system of production toward a more mechanized and industrial one required an increasing number of workers in order to provide the goods and services necessary for a higher standard of living. Table 5 shows that with the growth of population of 218% since

TABLE 5: TOTAL POPULATION AND GAINFUL WORKERS,
1870 TO 1930

Source: United States Bureau of the Census

Census Years	Population		Persons Engaged in Gainful Occupations		Percentage Engaged in Gainful Occupations
	Total	Percentage Increase Over 1870	Total	Percentage Increase Over 1870	
1870	38,558,371	..	12,505,923	..	32.4
1880	50,155,783	30.1	17,392,099	39.1	34.7
1890	62,622,250	62.4	23,318,183 ¹	86.5	37.2
1900	75,994,575	97.1	29,073,233	132.5	38.3
1910	91,972,266	138.5	37,454,000 ²	199.5	40.7
1920	105,710,620	174.2	41,854,000 ²	234.7	39.6
1930	122,775,046	218.4	48,829,920	290.5	39.8

¹ Corrected figures: for explanation, see Occupational Report for 1900, pp. lxvi-lxxviii.

² Corrected figures: adjusted for possible over-enumeration of agricultural laborers in 1910 and under-enumeration in 1920.

1870, the number of gainfully occupied increased 291%. In 1870 only 32.4% of the inhabitants were gainfully occupied. Within a period of four decades the proportion of gainful workers in the total population increased by about one-fourth, amounting to more than 40% in 1910. During the ten years following 1910 the World War and the influenza epidemic brought about a slight decrease in the proportion of the working population to total population, but from 1920 to 1930 the increasing trend was resumed.

The Source of Increasing Labor Supply

The increase in the proportion of gainfully occupied persons in comparison with the total population was due mainly to the increasing longevity of the people and to the entrance of women into gainful occupations.

The decrease in the birth rate since the Civil War and the decline in mortality among children and among all age groups up to 52 years affected the age distribution of the population by increasing the proportion of men and women of working age in the total population. In 1870, for example, persons between the ages of 20 years and 59 years accounted for 45% of the total, as compared with 53% in 1930, as shown in Table 6 and Chart 4.

The increase in the proportion of gainful workers to the population has been different for men and women. The proportion of male persons gainfully occupied increased from 54.7% of the total male population in 1870 to 61.3% in 1930. From the point of view of total labor supply the entrance of women into the employment market is of particular significance. In 1870 the proportion of women workers in the total female population was only 9.6%. In 1930, 17.7% of all females were gainfully occupied.

The increase in the proportion of gainful workers in the total population, due to increasing longevity and the entrance of women into employment, has been in part offset

TABLE 6: AGE DISTRIBUTION OF TOTAL POPULATION,
1870 TO 1930Source: United States Bureau of the Census
In Thousands

Age	1870	1880	1890	1900	1910	1920	1930
Under 20 years...	19,156	24,121	28,800	33,681	38,563	43,043	47,609
20 to 59 years....	17,465	23,206	29,785	37,241	47,024	54,603	64,686
60 and over.....	1,933	2,828	3,875	4,872	6,217	7,916	10,385
Total ¹	38,553	50,156	62,460	75,794	91,803	105,562	122,681

Percentage of Total

Age	1870	1880	1890	1900	1910	1920	1930
Under 20 years...	49.7	48.1	46.1	44.5	42.0	40.8	38.8
20 to 59 years....	45.3	46.3	47.7	49.1	51.2	51.7	52.7
60 and over.....	5.0	5.6	6.2	6.4	6.8	7.5	8.5
Total.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹ Does not include those whose ages were unknown.CHART 4: AGE DISTRIBUTION OF TOTAL POPULATION,
1870-1930

Percentage of Total



by the decline in the employment of young persons and of persons over 65 years of age.

From 1870 to 1930 the proportion of children between 5 and 15 years of age gainfully occupied or not at school declined from 10.7% to 2.9% of the total population, as shown in Table 7 and Chart 6. During the same period the proportion of persons attending school increased from 16.6% to 22.7% of the total population. From 1900 to 1930 the proportion of workers aged from 10 to 15 years in the total

TABLE 7: ESTIMATED DISTRIBUTION OF TOTAL POPULATION BY PRIMARY ACTIVITIES, 1870 TO 1930

Source: "Recent Social Trends in the United States, Report of the President's Research Committee on Social Trends," McGraw-Hill Book Company, New York, 1933

Activity Group	Percentage of Total Population						
	1870	1880	1890	1900	1910	1920	1930
Children under 5 years...	14.3	13.8	12.4	12.1	11.5	10.9	9.3
Children 5 to 15 years, gainfully occupied or not at school.....	10.7	6.8	6.8	6.7	3.8	3.7	2.9
Persons attending school..	16.6	19.8	18.6	17.7	19.6	20.6	22.7
Persons gainfully occu- pied.....	32.4	34.7	37.2	38.3	40.6	39.6	39.8
Males — percentage of total male population	54.7	57.8	60.2	61.2	62.9	61.8	61.3
Females—percentage of total female popula- tion.....	9.6	10.7	13.1	14.3	17.0	16.5	17.7
Housewives not gainfully occupied.....	21.3	21.9	21.7	21.6	21.2	21.5	21.3
Adults in institutions.....	.3	.4	.4	.5	.5	.6	.6
Not accounted for.....	4.4	2.6	2.9	3.1	2.8	3.1	3.4

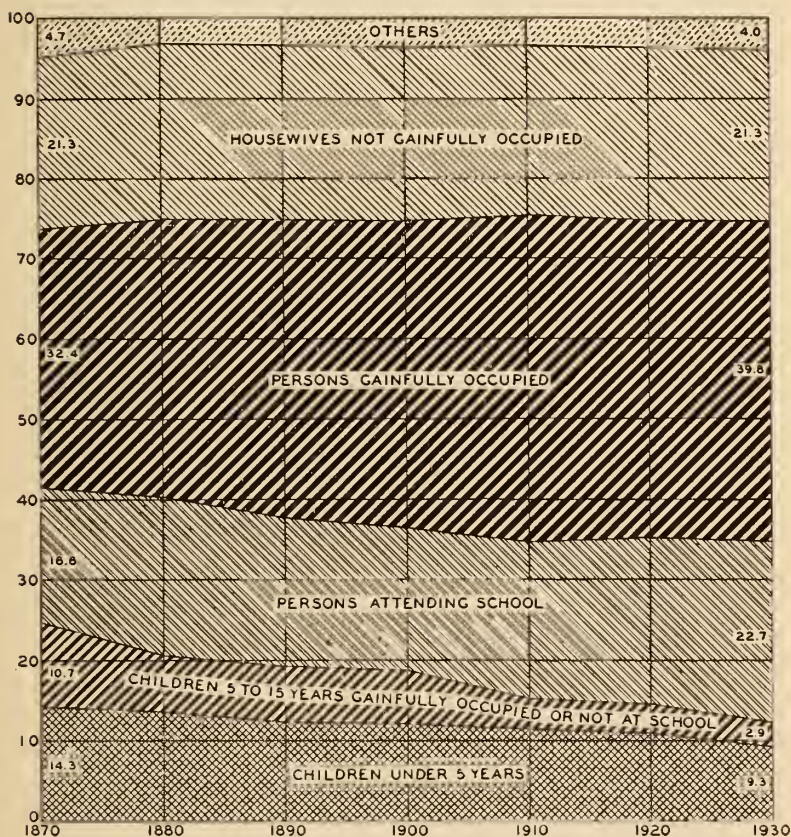
population declined over 75%. In 1890, 73.8% of all male persons over 65 years of age were gainfully occupied, as compared with only 58.3% in 1930.

The Productivity of Labor

The increase in the proportion of the working population to the total during the past sixty years was largely the result of several concurrent developments: The production per worker increased; the working time of the working popula-

tion was reduced; and the total production of goods and services was greatly increased relative to the whole population. In 1930 it required 398 workers per 1,000 inhabitants

CHART 5: DISTRIBUTION OF TOTAL POPULATION BY PRIMARY ACTIVITIES, 1870-1930
Percentage of Total



to produce the goods and services demanded by consumers, as compared with only 324 workers immediately after the Civil War.

What has occurred is an enormous increase in production relative to the growth of the whole population and of the working population, with a simultaneous decrease in the working time of the latter and an increase in production per worker. The use of machinery, together with improvements in organization and management, scientific discoveries, and the development of new products have made this possible without a reduction in the total opportunities for employment, but the process has been accompanied by great changes in the occupational distribution of the working population.

The period from 1870 to 1930 witnessed the development of railroads, automobiles, airplanes, tractors, harvesting machinery, electric power, typewriters, telephones, radio, illuminating and heating gas, modern plumbing, refrigeration, canning, central heating, and innumerable products and services which were previously unknown or were luxuries not available to the mass of the people. To produce these various goods and services, with generally shorter hours of work, has required the use of machinery to increase the output of the working population, and an expansion in the working population itself.

The evidence of the decrease in working time and the increase in efficiency of production will be seen more clearly in the next chapter, but certain broad comparisons of the growth in production with the whole population and the gainfully occupied population, presented in Charts 6 and 7, show the general trend.

Charts 6 and 7 show index numbers of the volume of production, production per capita of population, and production per gainful worker in manufacturing, mining, and agriculture, and in the three industrial groups combined from 1869 to 1934. The volume of manufacturing production in 1929 was 1,745% greater than in 1869; production per capita of population increased 475%; and the output per person gainfully occupied in manufacturing rose 259%. Dur-

CHART 6: VOLUME OF PRODUCTION, TOTAL AND PER CAPITA OF POPULATION, 1869-1934

Index Numbers, 1869 = 100

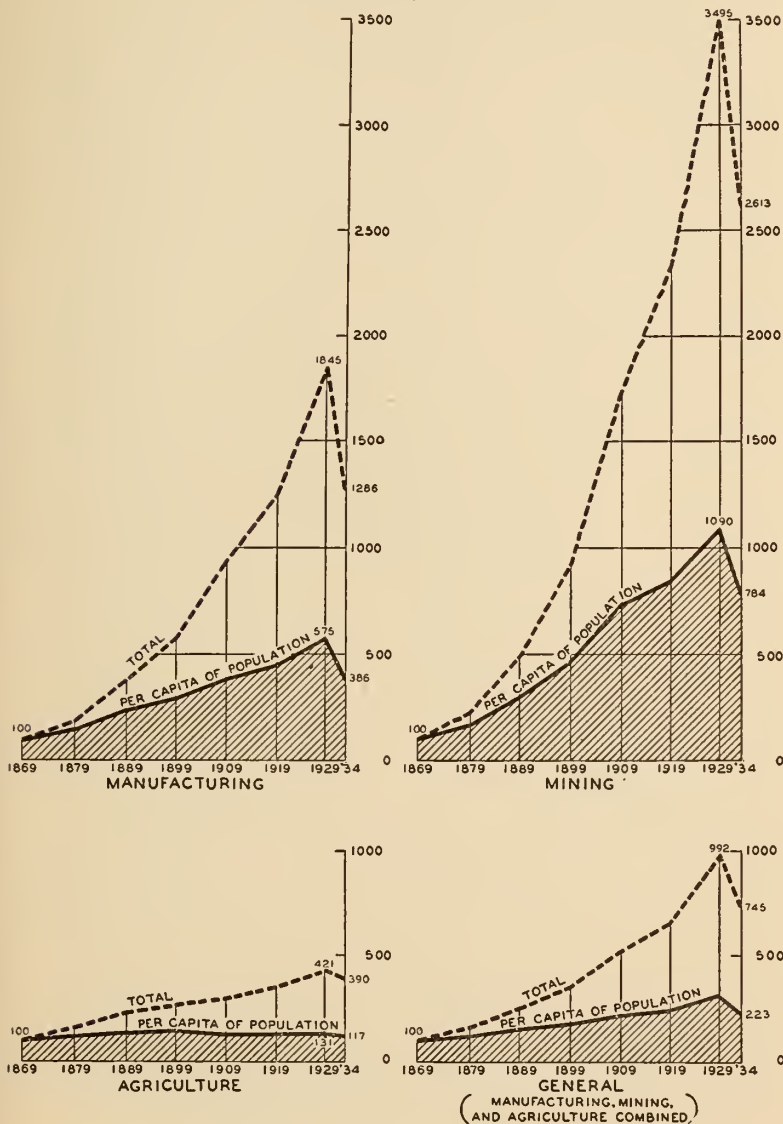
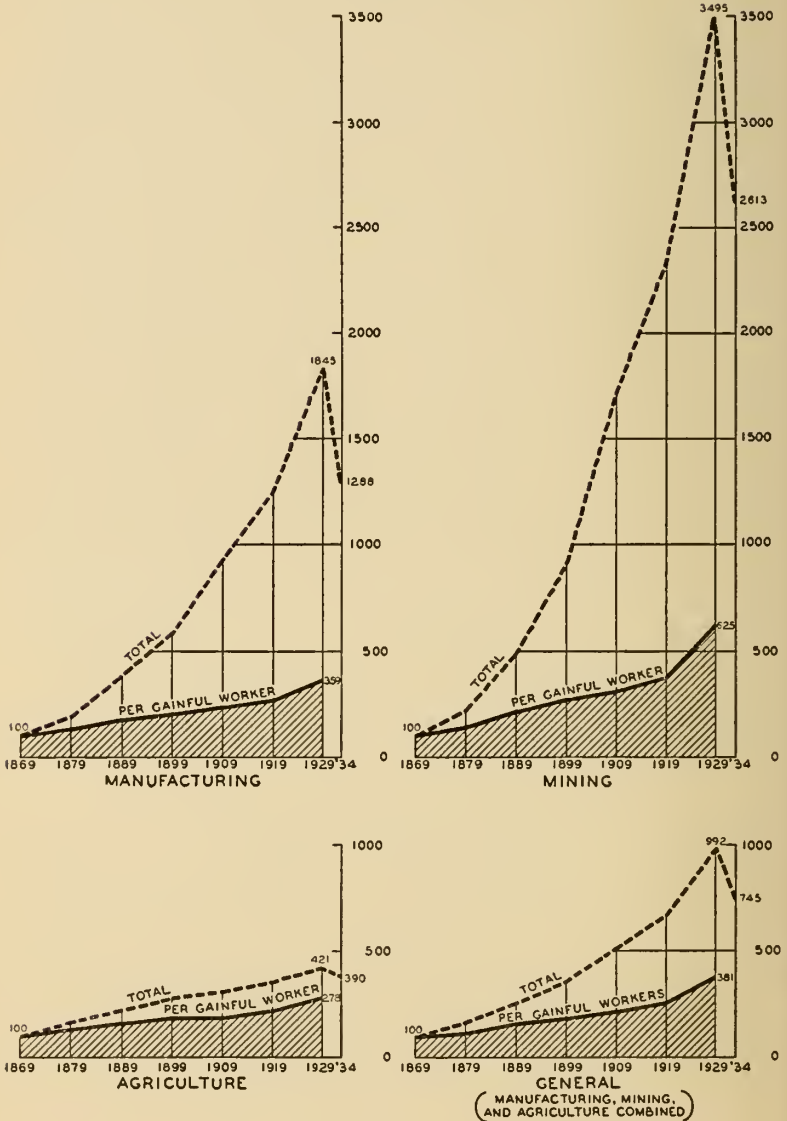


CHART 7: VOLUME OF PRODUCTION, TOTAL AND PER GAINFUL WORKER, 1869-1934

Index Numbers, 1869 = 100

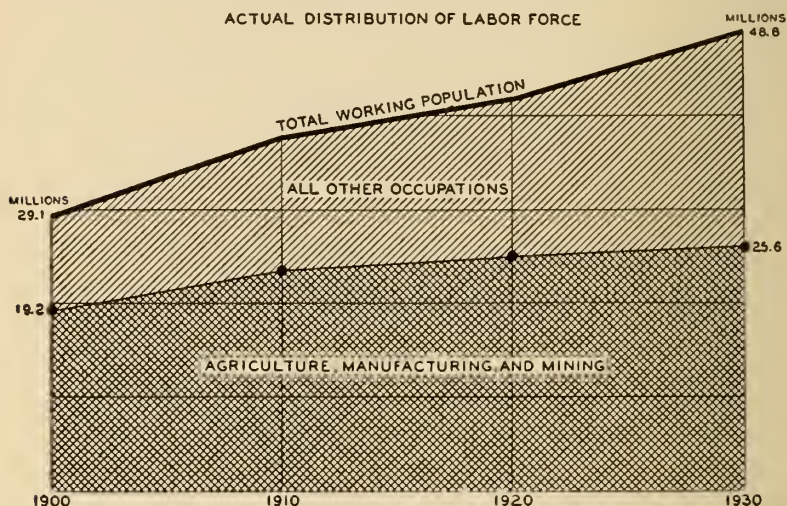


ing the same period, in the mining industry the volume of production increased 3,395%; production per capita of population rose 990%; and the output per person gainfully occupied in mining showed an increase of 525%. In agriculture the increase in production has been less striking. The volume of production rose 321%; production per capita of population, 31%; and production per gainful worker, 178%. The total volume of production in these three industrial groups combined was 892% larger in 1929 than in 1869; production per capita of population increased 210% and the output per gainful worker rose 281% during this period.

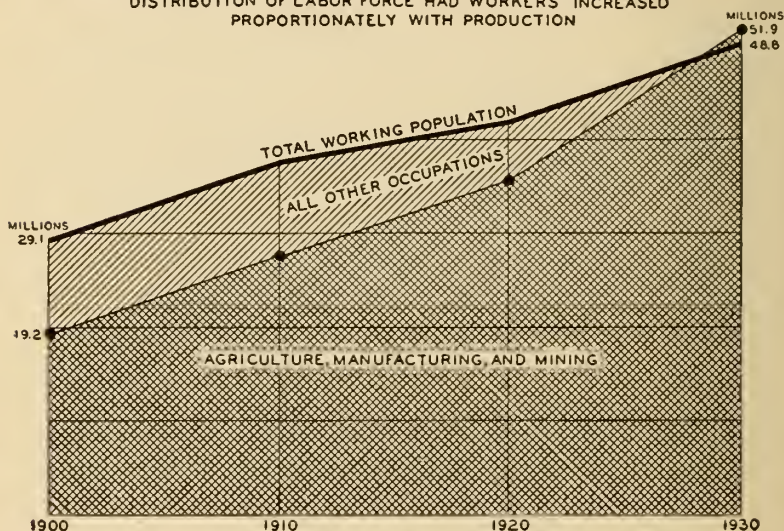
The history of the past 60 years shows clearly that without the help of machinery the vast increase in the output of goods on which our high standard of living is based could never have been achieved. Had the combined labor requirement in the production industries increased in proportion to output, the total required working force in agriculture, manufacturing, and mining would have exceeded, in 1930, the total number of gainful workers in all occupations enumerated by the census of that year.

The upper diagram in Chart 8 shows, for the census years 1900 to 1930, a comparison of the number of workers actually engaged in agriculture, manufacturing, and mining with the number in all other occupations. The lower diagram indicates the increased number of workers that would have been required in agriculture, manufacturing, and mining, if it is assumed that the number gainfully occupied in those industrial groups had kept pace with production. The lighter hatched portion in both of these diagrams shows the labor force available at each census period for the work to be done in all other fields of activity—forestry and fishing, transportation and communication, trade, clerical occupations, and public, professional, domestic, and personal services. If the increase in production had been achieved by the employment of additional labor rather than by the use

CHART 8: WORKING POPULATION AND PRODUCTION, COMPARISON OF ACTUAL DISTRIBUTION OF LABOR FORCE, 1900-1930, AND DISTRIBUTION ASSUMING THAT WORKERS IN AGRICULTURE, MANUFACTURING, AND MINING HAD INCREASED PROPORTIONATELY WITH OUTPUT



DISTRIBUTION OF LABOR FORCE HAD WORKERS INCREASED PROPORTIONATELY WITH PRODUCTION



of additional machinery, by 1920 the number of persons available for these occupational groups would have been reduced to about one-third of the number actually engaged in them. By 1930 the labor requirements of the three production industries would have exceeded by approximately three millions the total number of persons gainfully occupied that year.

The manufacturing industries, mining, and agriculture account for practically all of the production of commodities. The production of goods, however, represents only a portion of the productive economic activities. Before the goods reach the consumer they are transported; they enter into wholesale trade; their production, transport, and sale are financed in various ways; telephone, telegraph, and post office facilities are employed in the process of production and distribution; the services of thousands of department stores, chain stores, mail order houses, and other retail establishments are used; advertising is employed extensively in making the product or service known to the public. All these activities and others, such as insurance, building construction, exporting, and importing, contribute to the total productiveness of the economic system. They are combined and expressed in the form of index numbers of the physical volume of trade by Mr. Carl Snyder and are used by the Federal Reserve Bank of New York as a measure of physical growth of total trade. These indexes are shown in Table 8, with index numbers of the growth of population and gainfully occupied from 1870–1930. The tremendous increase in volume of trade—1,479%—during this period, compared with an increase of only 218% in the total population, and 278% in the gainfully occupied, indicates the extent to which the productive system has been able from decade to decade to raise the standard of living by placing larger quantities of goods and services at the disposal of the people.

These developments have required and been accompanied by great shifts in the occupational distribution of the working population which are of prime importance for an understanding of the consequences of the use of machinery.

TABLE 8: INDEX NUMBERS OF THE PHYSICAL VOLUME
OF TOTAL TRADE, POPULATION, AND GAINFULLY
OCCUPIED, 1870 TO 1930

Sources: Federal Reserve Bank of New York and
United States Bureau of the Census
1870 = 100

Year	Volume of Trade	Population	Gainfully Occupied ¹
1870	100.0	100.0	100.0
1880	191.8	130.1	134.5
1890	346.9	162.4	180.4
1900	719.5	197.1	224.9
1910	890.0	238.5	289.7
1920	1,670.4	274.2	323.8
1930	1,578.5	318.4	377.7

¹ Index numbers based on figures shown in Table 19.

OCCUPATIONAL CHANGES IN THE WORKING POPULATION

The growth of new industries which absorbed an increasing portion of the working population would not have been possible without a considerable improvement in the efficiency of production in agriculture, which was the basic industry of the country in 1870. Among the changes that have taken place in the occupational characteristics of the population, the relative, and later the absolute decline of agriculture as an employer of labor is the most important.

Decreasing Importance of Agriculture

In 1870 agriculture gave employment to nearly 7,000,000 persons, or to more than half of the total working population of the country. At that time most of the people lived in rural communities. Cities were few and far between. The national economy was predominantly agricultural. Manufacturing and trade were dependent primarily on agriculture

for their markets. The railroads derived a substantial part of their revenue from the transportation of agricultural products.

In 1930, as shown in Table 9 and Chart 9, less than 22% of the gainfully occupied were engaged in agricultural pursuits as farmers or agricultural workers. The number of persons working on farms increased until the end of the nineteenth century, but the rate of growth was much slower than that in any other occupation. In the second decade of the present century, the number of persons engaged in agriculture began to decline, until in 1930 the farmers and farm workers represented only about one-fifth of the total working population.

TABLE 9: DISTRIBUTION OF GAINFULLY OCCUPIED,
1870 TO 1930

Source: Census data 1870-1920 as adjusted by P. K. Whelpton, "Occupational Groups in the United States, 1820-1920," Journal of the American Statistical Association, September, 1926. Figures for 1930 adjusted by National Industrial Conference Board.

In Thousands

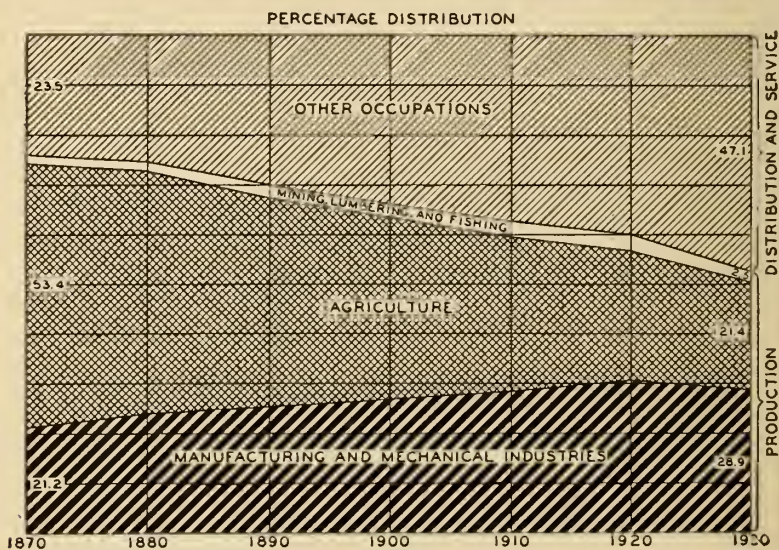
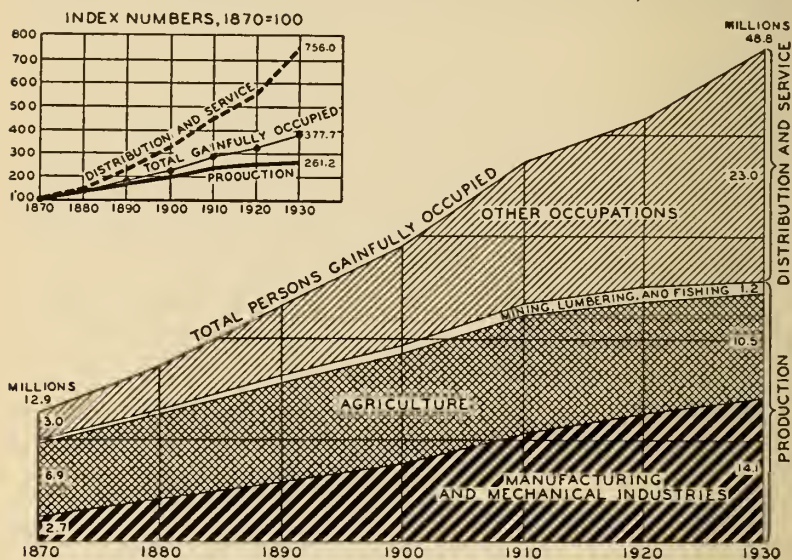
Year	All Occupations	Agriculture, Lumbering and Fishing	Manufacturing and Mechanical	Trade and Transportation	Domestic and Personal Service	Professional Service	Mining
1870	12,927	6,961	2,746	1,347	1,318	379	176
1880	17,390	8,595	4,185	2,122	1,622	602	264
1890	23,319	9,942	5,969	3,650	2,403	947	408
1900	29,073	10,889	7,854	5,444	3,076	1,213	597
1910 ¹	37,454	11,946	10,629	7,989	4,219	1,706	965
1920 ¹	41,854	11,193	12,819	10,433	4,207	2,112	1,090
1930	48,830	10,722	14,111	13,950	6,124	2,939	984

Percentage Distribution

1870	100.0	53.85	21.24	10.42	10.20	2.93	1.36
1880	100.0	49.42	24.07	12.20	9.33	3.46	1.52
1890	100.0	42.63	25.60	15.65	10.31	4.06	1.75
1900	100.0	37.45	27.01	18.73	10.58	4.17	2.05
1910 ¹	100.0	31.90	28.38	21.33	11.26	4.55	2.58
1920 ¹	100.0	26.74	30.63	24.93	10.05	5.05	2.60
1930	100.0	21.96	28.90	28.57	12.54	6.02	2.01

¹ Adjusted for possible over-enumeration of agricultural laborers in 1910 and under-enumeration in 1920.

CHART 9: PERSONS IN GAINFUL OCCUPATIONS, 1870-1930



This relative decline in agricultural workers did not take place at the expense of agricultural production. Introduction of machinery, better methods of cultivation, careful selection and testing of seeds, control of pests and disease—all of which increased the yield per man employed and per acre utilized—enabled agriculture fully to meet the demands of the domestic market and to produce a large surplus for export.

Manufacturing and Mechanical Industries

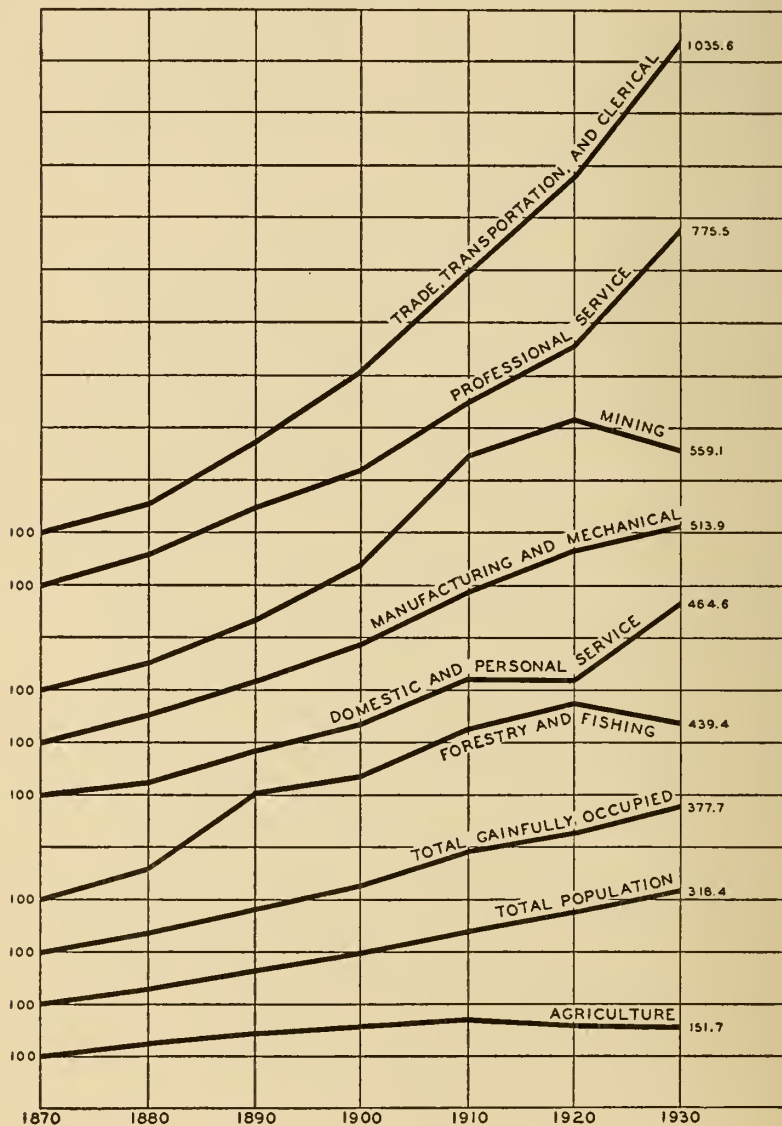
The decline in the opportunities for employment in agriculture was offset by an expansion in the manufacturing and mechanical industries, which experienced their most rapid growth from 1870 to 1920. After the Civil War these industries employed 2,746,000 workers, or 21.2% of the total working population, as compared with 6,961,000 workers engaged in agriculture.

From 1870 to 1920 employment in manufacturing and mechanical industries increased steadily both in actual numbers and in relation to the increase in the working population. In 1920 these industries employed 12,819,000 workers, or 30.6% of the total. From 1920 to 1930 the number of workers continued to increase, but the rate of growth declined. During this latter period the total working population grew more rapidly than manufacturing employment. As a result, the proportion of workers engaged in manufacturing declined from 30.6% of all gainful workers in 1920 to 28.9% in 1930.

In 1870 more than 75% of the total working force was engaged in agriculture and in the manufacturing, mechanical, and mining industries. In the preceding five decades from 1820 to 1870 the proportion of the gainfully occupied engaged in the production of agricultural commodities, manufactures, and products of mines had declined from 85% to 76%. In 1930 only 53% of all workers were engaged in the production of goods. This reduction in the proportion

CHART 10: PERSONS IN GAINFUL OCCUPATIONS, BY OCCUPATIONAL GROUPS, 1870-1930

Index Numbers, 1870 = 100



of workers employed in agriculture, manufacturing, and mining was accompanied by a remarkable increase in the volume of production and in the output per person employed.¹ These accomplishments were possible primarily because of the introduction of machinery. If the machine had not increased the output per person occupied in production of commodities, the extraordinary development of trade, transportation, and service industries could not have taken place. Workers would not have been available for these occupations and there would have been less need for them.

Trade and Transportation

While manufacturing was increasing production at a rapid rate and new products were being introduced in large numbers, the demands upon trade and transportation industries were enormously increased. Thousands of filling stations and garages, tens of thousands of drug stores, telephone and telegraph agencies, retail stores in urban centers, towns and villages, banks and brokerage offices, insurance agencies, shipping agencies—all these and many others indicate the extent to which the growing requirements of distribution have increased activity in trade and transportation.

In 1870 trade and transportation gave employment to 1,347,000 persons, or 10.4% of the total working population. In each decade after 1870 employment in these industries increased, until in 1930 they accounted for 13,950,000 persons, or 28.6% of all workers and afforded more employment to labor than agriculture and practically as much as the manufacturing and mechanical industries.

Domestic, Personal, and Professional Services

The number of workers engaged in domestic, personal, and professional services remained fairly constant in relation to the total working population from 1870 to 1920, absorbing

¹ See pp. 33–35.

about 10% of the total. From 1920 to 1930 the proportion increased from 10% to 12.5% owing to expansion and improvements in hotel service, barber shops, beauty parlors, and similar businesses.

Particularly significant as a measure of higher living standards is the great increase that has occurred since 1870 in the number of men and women engaged in professional services—doctors, lawyers, engineers, teachers, scientists, and journalists. In 1870 there were only 379,000 persons engaged in these professions. By the beginning of the present century the number had increased to 1,213,000. In 1930 the professions gave employment to 2,939,000 persons. From 1870 to 1930 the proportion of professional workers in the total working population increased from 2.9% to 6.0%.

SUMMARY

During the period of rapid introduction of machinery and technological improvements from 1870 to 1930, the increase in the working population was greater than the increase in the total population; the proportion of gainful workers in the total rose from 32.4% to 39.8%.

The increase in the proportion of gainful workers in the total population was made possible mainly by the increasing longevity of the people and the entrance of women into gainful occupations. The increase would have been greater if, at the same time, there had not occurred a marked decline in employment of young persons and of those over 65 years of age. The average efficiency of workers has thus increased because they are employed during the most productive period of their life. The underlying causes of this expansion in employment opportunities, however, were the great relative rise in production, together with the reduction in work time, made possible through the increased output of the working population that resulted from the use of machinery.

The increase in the number of gainfully occupied persons was accompanied by marked shifts in their occupational distribution. In 1870 more than one-half of the total working population was engaged in producing agricultural commodities. In 1930 agriculture gave employment to less than 22% of the total. During the same period the proportion of workers engaged in manufacturing and mechanical industries increased from 21.1% to 28.9%, and in professional services from 2.9% to 6.0%. In 1930 only 53% of the gainfully occupied were engaged in the production of goods, while 47% were required in trade, transportation, and the various service industries, as compared to the 76% and 24% respectively in 1870. This extraordinary shift was made possible largely through the introduction of machinery and technological improvements.

During the period of most rapid mechanization, 1870 to 1930, there has been an increase in employment opportunities, a decrease in the working span, a reduction of working hours, a lightening of the tasks of labor, an improvement in the efficiency of production, an extension of the span of life, and an enormous increase in production relative to the growth of population—all of which have contributed to a rise in the general standard of living.

CHAPTER III

MECHANIZATION, EMPLOYMENT, AND PRODUCTION IN THE MANUFACTURING INDUSTRIES

THE greatest progress in mechanization has been made in the manufacturing industries, and its effects will be most clearly shown in the experience of these industries since the turn of this century.

The chief source of data on the growth and effects of mechanization is the Census of Manufactures. Figures from this source regarding the number of wage earners are not comparable with those given in the Occupational Census, used in Chapter II. The Census of Manufactures includes only wage earners in plants doing an annual volume of business of \$5,000 or more¹ and covers only those workers who are actually employed. The Census of Occupations, on the other hand, enumerates all persons who state that they are customarily employed in a manufacturing occupation, regardless of whether or not they are actually working at the time of census taking. Furthermore, the Census of Occupations counts all persons engaged in manufacturing, without limitation as to size of establishment.

In this analysis the turn of the century must be the starting point, because the data from the censuses prior to 1899 are not comparable with those collected in later censuses. This period, however, is sufficient to show not only the extent of mechanization but also its effects.

HORSEPOWER AS A MEASURE OF MECHANIZATION

In the first place, it is necessary to determine some measure of mechanization. One commonly used is based on the statistics of "Installed Primary Power" collected by the Census of Manufactures. Primary power, as the term is used in the

¹ Prior to and including 1919 the minimum limit was \$500.

census, comprises not only power generated in manufacturing establishments, but also purchased power. Electric motors are included in the figures for installed primary power when run by current generated outside the plant. The horsepower of electric motors run by current generated in the establishment is reported separately, but does not form part of the total primary power, as it is already included in the figures for the prime movers—engines, water wheels, turbines, etc.—which generate the electric current.

The total figures of "Installed Primary Power," considered as a measure of technological advance in manufacturing industries is, however, subject to certain limitations. The censuses from 1899 to 1929 are not exactly comparable in their coverage, although this is not a serious objection.¹ The increase in the use of electric motors run by purchased current has inflated the total to some extent, for the reason that the sum of the rated horsepower of the individual electric motors in any establishment using purchased electric energy is always greater than the horsepower of the single prime mover, such as a steam engine that would be needed to produce the required amount of power for that establishment. The horsepower reported is the potential power of the prime movers or motors, not the horsepower actually used. Finally, horsepower installed does not reflect improvements in the efficiency of equipment by means of which a modern technological device, using less power, may produce a greater output than an older, outmoded machine.

On the whole, criticism of horsepower installed as a measure of mechanization rests on the ground that it exaggerates the degree of mechanization, not that it does not fully show its extent.

¹ Since in 1921 establishments with a product exceeding \$500 but less than \$5,000 employed only 0.6% of the wage earners in all establishments, and produced only 0.3% of the total value of products, it is evident that the inclusion or exclusion of these small establishments would have only a microscopic effect on the figures for the total amount of horsepower installed. See "Biennial Census of Manufactures, 1921," Washington, D. C., 1924, p. 5.

INCREASE IN HORSEPOWER EQUIPMENT

Table 10 shows that from 1899 to 1929 the number of wage earners in the manufacturing industries increased by 88%, compared with the population growth of 62%; that the quantity of goods produced was over three times as great in 1929 as at the beginning of the period; that horsepower installed quadrupled its 1899 capacity; and that the output per man-hour nearly doubled.

TABLE 10: INDEX NUMBERS OF THE GROWTH IN POPULATION, WAGE EARNERS, VOLUME OF PRODUCTION, AVERAGE WEEKLY HOURS IN MANUFACTURING, MAN-HOURS IN MANUFACTURING, PRODUCTION PER WAGE EARNER, AND HORSEPOWER, 1899 TO 1929

Census Year	Population ¹	Wage Earners ¹	Production ¹ (Quantity)	Average Weekly Hours Worked in Manufacturing ²	Man-Hours in Manufacturing	Production per Wage Earner ¹	Horsepower ¹
1899	100	100	100	100	100	100	100
1904	110	114	122	98	111	107	133
1909	121	137	159	96	132	116	186
1914	131	146	169	91 ⁴	132	116	224
1919	140	191	214	89	169	112	294
1921	145	147	170	80	118	116	⁵
1923	149	186	261	87	161	140	332
1925	154	178	269	85	151	151	359
1927	158	177	272	84	149	154	390
1929	162	188	316 ³	85	160	168	431

¹ Source: "Fifteenth Census of the United States, Manufactures: 1929," Vol. I.

² Based on Paul H. Douglas, "Real Wages in United States, 1890-1926," for years 1899, 1904, 1909, 1919. National Industrial Conference Board, "Wages in United States, 1914-1930," for years 1914, 1921-1929.

³ Based on National Bureau of Economic Research, Bulletin 51.

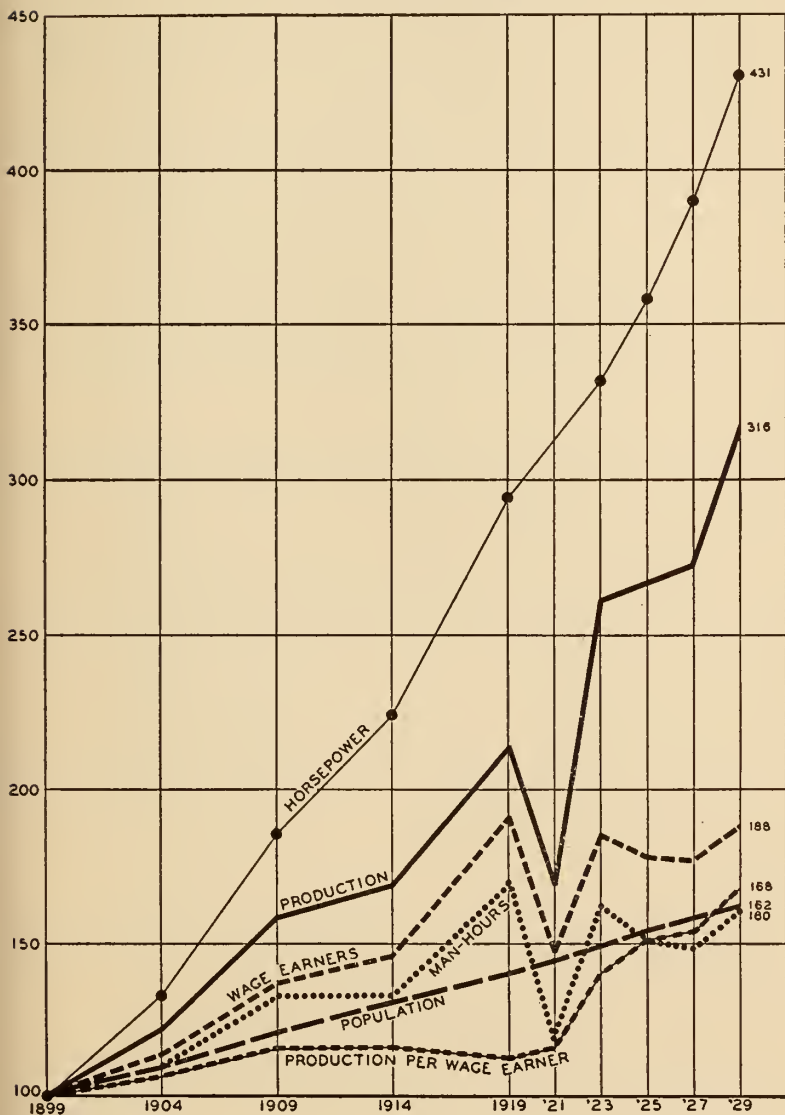
⁴ July.

⁵ Data not available.

Chart 11 shows that horsepower equipment grew at a substantially faster rate than the labor force. By 1904 it had already increased 33%, or about two and one-half times as fast as the labor force. This relationship was virtually sus-

CHART 11: POPULATION, LABOR FORCE, MAN-HOURS, HORSE-POWER, AND PRODUCTION, MANUFACTURING INDUSTRIES, 1899-1929

Index Numbers, 1899 = 100



tained until the end of the last decade, when horsepower equipment showed an increase for the thirty years three and one-half times greater than that of the labor force. Part of this difference was due to the fact that the number of wage earners in the manufacturing industries declined somewhat from 1919 to 1929.

By 1929 the machine had so greatly increased the productiveness of industry that the labor force, which had less than doubled, produced an output more than three times that of 1899. This was an increase in the output per wage earner of 68%. In fact, the output per man-hour nearly doubled during these thirty years, but the decline in weekly hours worked reduced the effective increase per wage earner to 68%. To obtain this greater output per wage earner, the amount of installed horsepower had to be more than quadrupled.

This indicates that an extremely large amount of horsepower was required to increase the output per worker by two-thirds. To illustrate:

If it is assumed that the relationship between labor, installed horsepower, and physical output had remained the same during the period from 1899 to 1929, the 216% increase in physical output would have necessitated a corresponding increase in the number of wage earners and in the amount of installed horsepower. Actually, as a result of changes in manufacturing processes and the development of new industries, there was an increase of only 88% in the number of wage earners, while, on the other hand, installed horsepower increased 331%.

The increased importance of machinery in relation to labor is also indicated by the decline of 15% in the average number of hours worked per week. Although the number of wage earners increased 88% during the period under consideration, man-hours increased only 60%. If no reduction in working hours had taken place, it may be assumed that approxi-

mately 15% fewer wage earners would have been required in 1929 than were actually employed.

If it is considered, furthermore, that horsepower equipment is only partially responsible for the increases in output per worker or per man-hour and that non-mechanical improvements in methods of operation, such as the greater efficiency of management and labor, were responsible for a substantial part of the increase, it is apparent that these comparisons do not give a complete picture of the change that has taken place with respect to the relative contributions of labor and capital toward increased output.

Among the causes other than machinery and power which appear to have contributed to increased productive efficiency, William G. Roylance has suggested the following nine factors:¹

“(1) A more adequate and a more even flow of raw materials to the manufacturing industries.

“(2) More easily workable materials, better adaptation of materials to purposes of manufacture and standardization of materials.

“(3) A faster and more even flow of products from the mines, the farms, and the factories to markets, reducing inventories and obviating the congestion of goods in warehouses.

“(4) Improved factory layout and machine assembly, and more efficient utilization of machinery and equipment.

“(5) More economical distribution and application of power.

“(6) Improved working conditions and better adjustment of working time.

“(7) Better organization of the working force, including personnel selection and distribution.

“(8) More effective application of the energy and skill of workers (rationalization of movements, etc.).

“(9) Direct increase in individual efficiency.”

¹ William G. Roylance, “Significance of Non-mechanical Factors in Labor Productivity and Displacement,” *Monthly Labor Review*, November, 1933, p. 1028.

The available statistical data fail to show, not only the relative contribution of these various factors, but also the full extent of the changes that have taken place as a result of mechanization. The various measures of change shown in Table 10 do not fully indicate the growth of horsepower, labor, or physical output, because the nature of the factors which these indexes represent has changed throughout the period of observation.

First of all, the quality of goods has been improved materially. This fact introduces a degree of error into the physical output data, because the present product is of much better grade. Second, the increased physical product of 1929 contains a considerable volume of manufactured goods which were virtually non-existent at the beginning of the period. Furthermore, the labor force today is fundamentally of a higher type than that of 1899, because the educational system has provided added facilities for technical training and also because the more complex economic system of today demands that the worker acquire higher standards in order to survive successfully the competitive struggle for jobs. Finally, the technological innovations have undergone substantial improvements that are not reflected by horsepower data.

The changing and improving quality of goods is evidence of a greater degree of technological change and a more efficient utilization of labor per unit produced than the figures show. Great progress made along lines of accuracy, design, finish, checking methods, supervision, and so forth, indicates that the unit manufactured in 1930 is of a far superior quality and usefulness than that produced at the beginning of the century. For example, steel manufactured in 1930 was of a much higher quality than that produced in 1900. The same is true of rubber products, processed food articles, and of practically all other manufactured goods.

It appears, then, that machines are not installed wholly for the purpose of saving labor, and that they also serve as

devices for the improvement of the final product or for the creation of an entirely new commodity. This is shown in a study of inventions, made by Dr. S. C. Gilfillan.¹ His analysis of 120 of the socially most valuable inventions, made during the last generation, indicates that only one-third of them were predominantly labor saving; 8% were land saving, such as the skyscraper or geophysical prospecting; 14% were capital saving, like multiplex telegraphy or fire protection systems; and the remaining 45% were inventions creating or perfecting new types of consumers' goods.

This analysis indicates that inventive genius has been directed primarily along lines designed to create additional demands for goods, services, and labor rather than to diminish the demand for labor. This is especially significant inasmuch as inventions reflect to a degree the demand for improvements in the fields in which they are made. An examination of the development of new manufacturing industries throws further light on this point.

EMPLOYMENT CREATED BY NEW MANUFACTURING INDUSTRIES

The importance of new industries, which are being constantly created and developed by advancement in science, invention, and technology as sources of new opportunities for employment of labor, is shown in Table 11. There it appears that eighteen new manufacturing industries alone, which came into existence since 1879, absorbed about one-eighth of all the labor employed in manufacturing in 1929.

Two of these eighteen industries comprise the automobile industry which occupies the first place as an employer of labor. In 1929 it gave employment to some 447,000 workers, one-half of whom were engaged in the manufacture of vehicles and the other half in producing automobile bodies and parts.

¹ S. C. Gilfillan, "Inventions and Discoveries," *The American Journal of Sociology*, May, 1932, p. 869.

TABLE 11: WAGE EARNERS IN 18 NEW MANUFACTURING INDUSTRIES SINCE 1879

Source: United States Bureau of the Census

Industry	Average Number of Wage Earners 1929
Electrical machinery, apparatus, and supplies.....	328,722
Motor vehicles, not including motorcycles.....	226,116
Motor vehicle bodies and parts.....	221,332
Rubber tires and inner tubes.....	83,263
Manufacture of gasoline ¹	39,411
Rayon and allied products.....	39,106
Manufactured ice.....	32,184
Aluminum manufactures.....	21,210
Typewriters and parts.....	16,945
Refrigerators, mechanical.....	16,883
Cash registers and adding and computing machines.....	16,840
Oil, cake and meal, cottonseed.....	15,825
Aircraft and parts.....	14,710
Phonographs.....	14,416
Photographic apparatus and materials.....	12,967
Motion picture apparatus except for projection in theaters.....	10,784
Asbestos products ²	8,092
Fountain pens ³	4,508
Total, 18 new industries.....	1,123,314
Total, all manufacturing industries.....	8,838,743

¹ For the reason that gasoline is chiefly used as a source of power in another new invention—the internal combustion engine, around which has been built up one of our greatest industries—the number of employees engaged in the manufacture of gasoline has been estimated for this list.

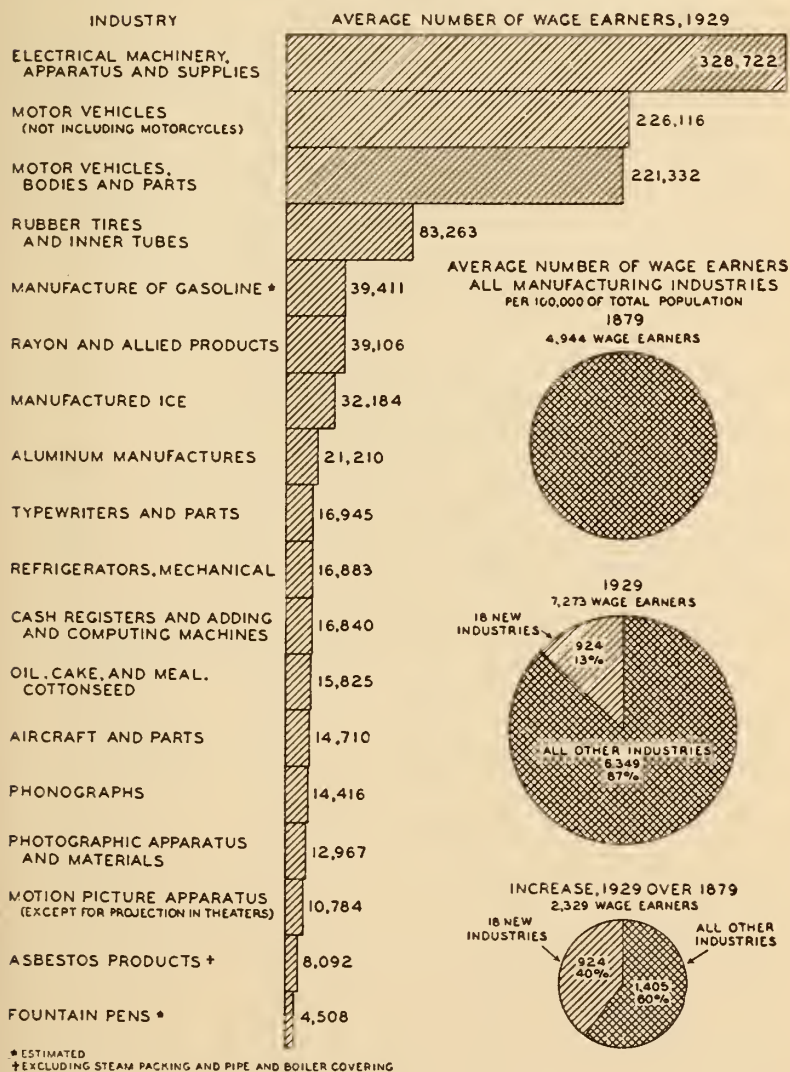
² Excluding steam packing and pipe and boiler covering.

³ Estimated.

The electrical machinery industry occupies second place, with an employment of 329,000 workers in 1929.

The relative importance of these new industries as employers of labor in relation to all manufacturing activities is shown in Table 12 and Chart 12. All manufacturing industries in 1879 employed 49,437 wage earners for every million inhabitants in the United States. In 1929, the population had grown to about two and one-half times its size in 1879 and the manufacturers employed 72,731 wage earners per million of population, an increase of 23,294 workers per million, or close to 50% over the ratio of 1879. No less than two-fifths of this increase in employment was brought about by these

CHART 12: WAGE EARNERS IN 18 NEW MANUFACTURING INDUSTRIES SINCE 1879



new industries. They accounted for 9,243 wage earners per million inhabitants in 1929.

In 1929 these new industries gave employment to 1,123,-314 workers. This figure, however, does not measure the total contribution of science, invention, and technology to increased employment. It covers only the field of manufacturing and then only some of the more important activities within that field. New jobs have also been created in such important fields of activity as public utilities, motion picture production, and radio broadcasting, as well as in connection with the transportation and distribution of goods and services produced by these newly established manufac-

TABLE 12: INCREASE IN EMPLOYMENT DUE TO 18 NEW INDUSTRIES SINCE 1879

Source: United States Bureau of the Census

Item	Total, in Thousands	Per Million of Population
Wage earners in factories ¹ in 1879.....	2,427	49,437
Wage earners in factories in 1929.....	8,839	72,731
Difference of 1929 over 1879.....	6,412	23,294
Wage earners in 18 new industries in 1929....	1,123	9,243
Percentage of increase in employment due to new industries.....	18%	40%

¹ Correction for wage earners in hand and neighborhood industries estimated.

turing industries. Even on this limited basis, however, Table 12 shows that these selected industries accounted for 18% of the total increase in employment in the field of manufacturing and for 40% of the increase in the per capita employment in the manufacturing industries from 1879 to 1929.

The growth of power equipment among all the manufacturing industries since the turn of the century is shown in Table 13. Although there was considerable fluctuation in the number of manufacturing establishments operating during the thirty years 1899-1929, no definite long-term movement is noticeable. In 1929 there was approximately the

same number of manufacturing establishments in the United States as in 1919. This does not mean that there have been no inter-industrial or intra-industrial shifts in the number of establishments among the manufacturing industries. As a matter of fact, there have been some very definite changes; such as the decline in the liquor and beer manufacturing, carriage factories, cigar and cigarette plants, and numerous

TABLE 13: NUMBER OF ESTABLISHMENTS, WAGE EARNERS, AND HORSEPOWER IN MANUFACTURING INDUSTRIES, 1899 TO 1929

Source: United States Bureau of the Census

Year	Number of Establishments ¹	Average Number of Wage Earners ¹	Total Horsepower ⁴	Horsepower	
				Per Establishment	Per Wage Earner
1899 ¹	207,514	4,712,763	9,960,980	48	2.11
1904	145,033	5,362,030	13,296,394	92	2.48
1909	175,142	6,472,616	18,551,737	106	2.87
1914	177,110	6,896,190	22,290,899	126	3.23
1919	214,383	9,000,059	29,327,669	137	3.26
1923	196,309	8,778,156	33,094,228	169	3.77
1925 ²	187,390	8,384,261	35,772,628	191	4.27
1927 ³	191,866	8,349,755	38,825,681	202	4.65
1929	210,959	8,838,743	42,931,061	204	4.86

¹ Figures for 1899 include establishments reporting products valued at \$500 or more; those for 1904 and subsequent years include establishments reporting products valued at \$5,000 or more.

² Coffee and spice, roasting and grinding, not canvassed.

³ Poultry killing, dressing and packing, wholesale, not canvassed.

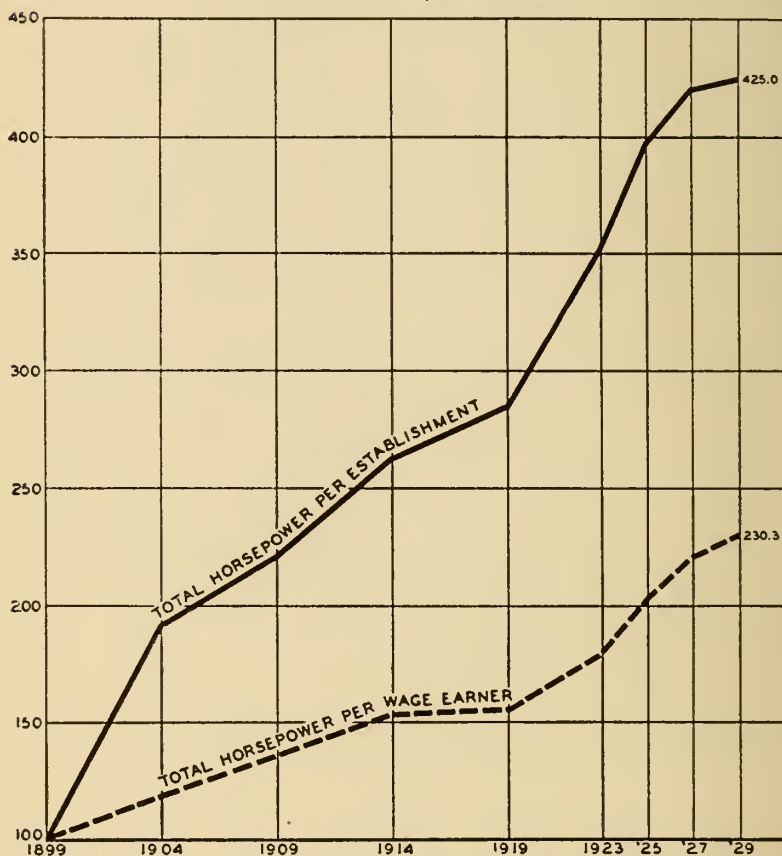
⁴ Figures for 1919 and earlier years include establishments reporting products valued at \$500 or more; those for 1923 and subsequent years include establishments reporting products valued at \$5,000 or more.

others. However, these contractions have been neutralized by increases in other lines of activity.

The fact remains that the increased output of manufactures was brought about not by spreading the work out over more plants, but by an increase in the capacity of establishments. This increase was made possible by applying more labor and power to the operation of these plants. During the thirty years following 1899 the wage earners attached to the manufacturing industries grew to over nine million,

CHART 13: INSTALLED PRIMARY POWER PER ESTABLISHMENT
AND PER WAGE EARNER, MANUFACTURING INDUSTRIES,
1899-1929

Index Numbers, 1899 = 100



or to approximately twice the number of workers employed by them in 1899.

Mechanization, so far as it can be measured by total horsepower installed, increased from about ten million horsepower installed in 1899 to more than four times that amount in 1929. Since the number of plants had remained fairly

constant throughout this period, the manufacturers employed more than four times as much horsepower per plant at the end of the period than at the beginning of it. Each worker used on the average more than twice as much machinery in 1929 as in 1899. In other words, power was utilized more and more as a means of increasing output. This is especially evident during the period 1919 to 1929, when, despite a slight decrease in the number of wage earners, the physical output increased 48%.

Thus, the installation of machines in industrial plants made possible the release of wage earners for work in other fields. Labor so redirected into other channels was subject to less burdensome work, as indicated by the increased number of persons in trade and clerical occupations. Furthermore, it is probable that the tasks performed by the workers remaining in the manufacturing industries demanded a continually diminishing degree of physical energy.

MECHANIZATION IN INDUSTRIAL GROUPS

Table 14 indicates that neither the degree of mechanization nor its rapidity of growth are uniformly distributed among the various manufacturing industries. In 1899 the food and kindred products industries used 4.03 horsepower per worker, or about twenty times as much as the tobacco industry, which used only 0.17 horsepower per wage earner. By 1929 the manufacturers of food products were in the sixth place in order of mechanization, while chemicals headed the list with 8.8 horsepower per worker. Within the thirty years the most rapid acceptance of the machine took place in the vehicles for land transportation industries, with a growth of horsepower per wage earner of 317.7%, whereas the smallest development was recorded by the food industries, with an increase of 22.6%.

Such fluctuations in the growth and utilization of machinery at any given time are brought about by the inherent

differences within the industries. Most important in this respect are such factors as the size and weight of the product, the uniformity of the raw materials entering into the final unit, and the degree of standardization that is attainable. Furthermore, differences in mechanization are caused by inequality of wages, the age and size of the enterprise, and the attitude of the management and employees. Combined,

TABLE 14: HORSEPOWER PER WAGE EARNER BY INDUSTRIAL GROUPS, 1899 TO 1929

Source: Harry Jerome, "Mechanization in Industry," National Bureau of Economic Research. New York, 1934. Based on Census of Manufactures and rearranged by Day & Thomas in "The Growth of Manufactures" for 1899-1923

Industrial Groups	1899	1909	1919 ¹	1925 ¹	1929 ¹
Food and kindred products.....	4.03	4.44	4.05	4.64	4.94
Textiles and their products.....	1.36	1.58	2.03	2.46	2.43
Iron and steel and their products.....	2.94	4.44	5.10	6.76	7.58
Lumber and its manufactures.....	3.15	3.56	4.11	3.88	4.39
Leather and its finished products.....	.64	.91	1.10	1.31	1.37
Paper and printing.....	3.06	4.02	4.67	5.70	6.45
Chemicals and allied products.....	2.34	3.84	4.79	7.40	8.80
Stone, clay and glass products.....	2.20	3.62	5.29	6.70	8.79
Nonferrous metals and their products...	1.33	1.86	2.90	3.96	4.76
Tobacco manufactures.....	.17	.17	.28	.32	.56
Rubber products.....	1.95	2.49	2.71	4.65	5.52
Vehicles for land transportation including railway repair shops.....	.79	1.29	1.50	2.53	3.30

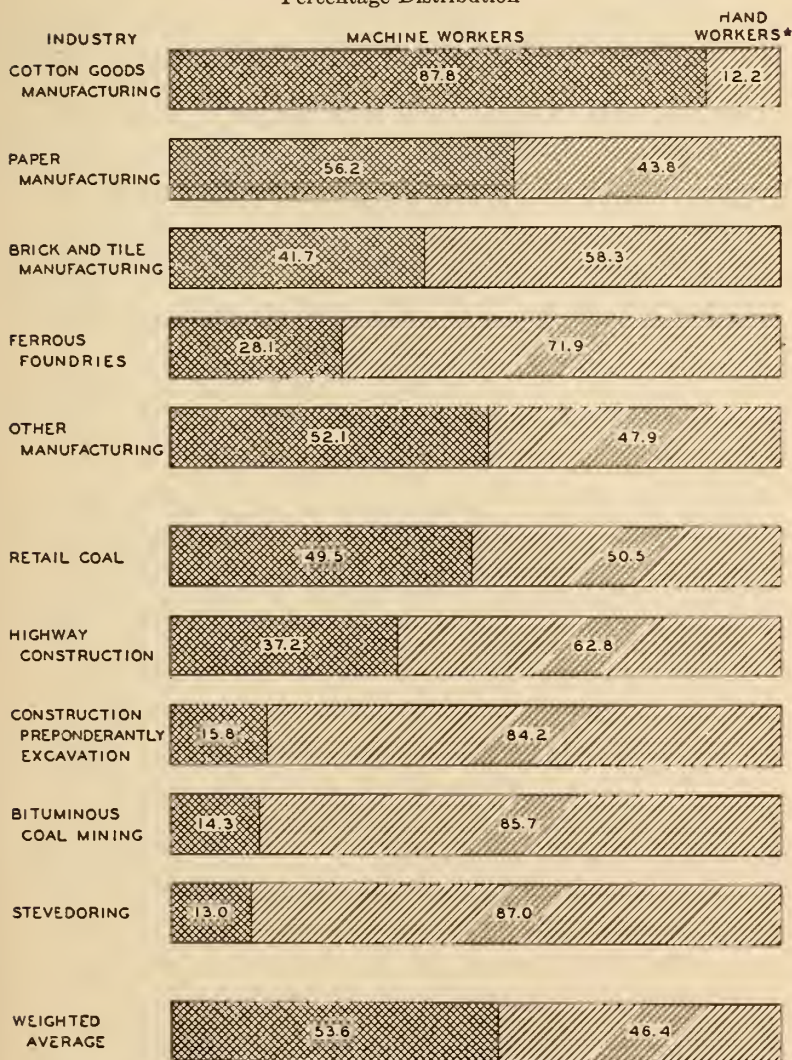
¹ Figures based upon wage earners in plants with value of product \$5,000 or more and exclude rented power other than electric. The horsepower figures for 1919, although made as comparable as possible with the subsequent censuses, do include a small amount of power in establishments with products less than \$5,000. The data for 1925 and 1929 are adjusted to make the classifications as comparable as possible with those for earlier years.

these factors are responsible for the wide variation in the rate, as well as the degree, to which the various industries have been mechanized. It is impossible to measure the influence exerted by any specific element. However, some generalizations concerning mechanization may be drawn from the results of a case study undertaken in 1925,¹ presented in Table 15. The results of this investigation indicate a greater degree of mechanization in some fields of

¹ For more complete data on this study see Harry Jerome, *op. cit.*, p. 275.

CHART 14: HAND AND MACHINE WORKERS, SELECTED INDUSTRIES, 1925

Percentage Distribution



* INCLUDES TEAMSTERS

activity than in others. Chart 14 shows the percentage distribution of machine and hand workers in the industries investigated.

The percentage of machine workers in the ten industrial groups, embodying some 472 plants and over 90,000 workers, varied from industry to industry. The average for the entire sample was 52% machine workers and 48% hand workers, supervisors, and teamsters. The highest proportion of machine workers, 86%, was found in the cotton goods industry, and the smallest proportion, 12%, in stevedoring.

TABLE 15: PERCENTAGE DISTRIBUTION OF HAND AND MACHINE WORKERS IN SELECTED INDUSTRIES IN 1925

Source: Harry Jerome, *op. cit.*, p. 275

Industry	Machine Workers	Hand Workers	Supervisors	Teamsters
Total, all plants.....	52	44	3	1
Cotton goods.....	86	12	2	1
Paper.....	54	42	4	1
Retail coal.....	49	46	1	4
Brick and tile.....	40	53	4	3
Other manufacturing.....	50	45	4	1
Highway construction.....	35	42	6	17
Ferrous foundries.....	27	69	4	1
Construction preponderantly excavation.....	15	78	5	2
Bituminous coal mining...	14	82	2	2
Stevedoring.....	12	80	8	1

¹ None, or less than one-half of one per cent.

The industries engaged in the production of fabricated commodities, such as cotton goods and paper products, had the largest proportion of machine operators, and the handling processes, on the order of stevedoring, excavation, and the like, used only a small proportion of machine workers.

The analysis, based on Tables 14 and 15, leads to the following conclusions: First, mechanization varies both in degree and in the rate of introduction from industry to industry; second, mechanization varies between the different processes in the same industry; and, third, fabricating processes have a tendency to be more highly mechanized

than handling processes. It then follows that mechanization is not as widespread as many are inclined to believe. Furthermore, there appear to be wide areas in the industrial field yet to be conquered by technology in order to bring about a greater and more uniform use of mechanical devices.

HORSEPOWER, WAGE EARNERS, AND PRODUCTION BY INDUSTRIAL GROUPS

From the turn of the present century until 1914 mechanization made rapid progress in manufacturing industries. The increase in horsepower per wage earner, shown in Chart 15 was accompanied by a steady growth in the labor force, both elements combining to increase production in all of the twelve industrial groups. Old industries were being gradually forced out and new industries developed, bringing about a shift in the occupations of the workers.

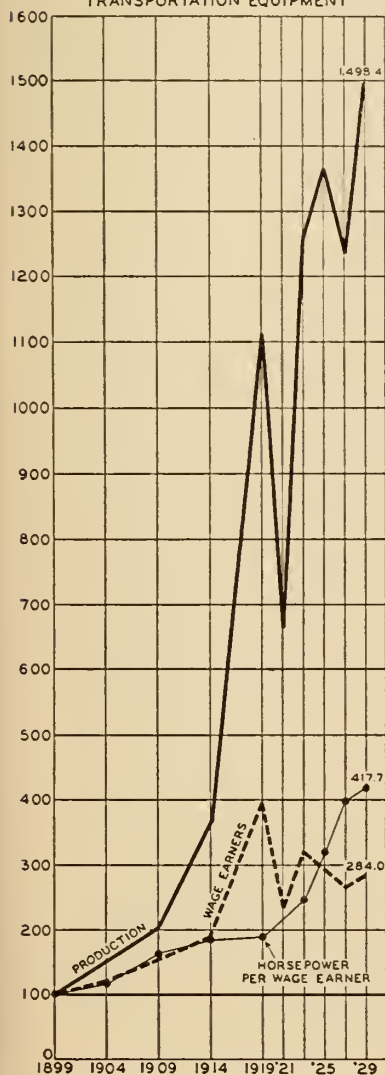
The World War, however, brought about almost immediately a complete change in the situation. A study of the various industrial groups shows that employment in industry increased abruptly during this period, bringing about a sharp increase in production. The increase in installed power during those years only slightly exceeded the increase in the number of workers. In addition, workers became independent and indifferent because of the tremendous demand for their services. From 1914 to 1919 the production per wage earner declined 3% and production per man-hour about 1%. After 1923 mechanization continued to grow, although at a less rapid rate than in the fifteen years prior to the War.

Outside of a few exceptions, those industries which advanced most rapidly along technological lines likewise drew most heavily on the labor supply, while industries which developed more slowly in mechanization absorbed smaller portions from the available working force.

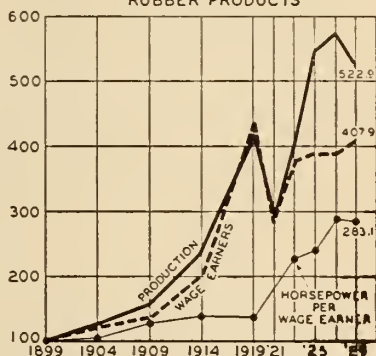
CHART 16: PRODUCTION, WAGE EARNERS, AND HORSEPOWER PER WAGE EARNER, SELECTED INDUSTRIES, 1899-1929

Index Numbers, 1899 = 100

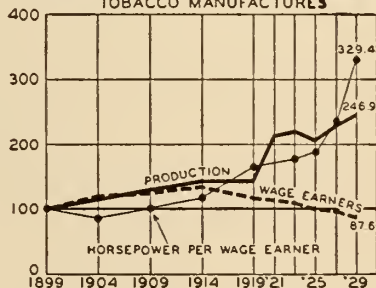
TRANSPORTATION EQUIPMENT



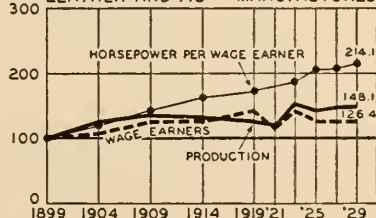
RUBBER PRODUCTS



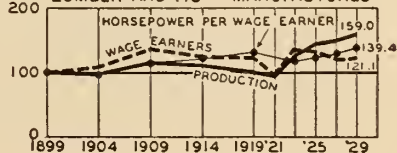
TOBACCO MANUFACTURES



LEATHER AND ITS MANUFACTURES



LUMBER AND ITS MANUFACTURES



Such close relationship between labor growth and mechanization is to be expected, because mechanization is reflected in lower production costs per unit produced or in improvements in the quality and adaptability of the commodity. Price reductions tend to broaden the market, provided the commodity has an elastic demand. Under such conditions, the increased sales make possible the re-employment of workers laid off when the labor saving device was installed.

The automobile industry is an outstanding example. If the cost of the average car were about \$5,000, the market for it would be limited because of the prohibitive price. With the average price only one-tenth of that sum, about \$500, the market may increase twenty, thirty, or even a hundred fold. A good portion of the population in the lower income groups, which comprise the bulk of the population, can afford to own a car, and some people even buy two or three of the less expensive kind. Not only was larger employment created in the direct production processes, but more auxiliary labor was required to handle the increased volume in the sales, bookkeeping, shipping, and other departments within the plant. Allied industries likewise were stimulated in order to meet the demand for additional raw materials, power, and more adequate transportation facilities. Furthermore, with the increased use of automobiles, trade and service industries expanded to meet the growing needs of motor users.

Thus, machines, by decreasing costs and prices, stimulate sales, bringing about a fan-like movement of employment spreading throughout the innumerable fields of the industrial system. As pointed out in Chapter II, there has been a tremendous increase in the number of workers employed in the trade, transportation, and service industries which has more than offset the slight decline during the decade 1919-1929 in the number of wage earners in the manufacturing industries.

Price and Elasticity of Demand

The experience of the automobile industry shows the effect of price reductions on the consumption of a commodity for which the demand is elastic. In the construction industry, on the other hand, a comparatively rigid cost level has prevailed for many years. High costs in this industry are due primarily to lack of mechanization. For this reason, it is believed that the modern pre-fabricated type of construction would revolutionize the industry, by applying the principles of mass production, increasing the output per worker, and reducing costs, which would eventually make possible the ownership of homes by a greater proportion of the population.

Four industries—lumber, leather, tobacco, and stone, clay and glass products—which show in recent census years either a definite decline in the number of wage earners or a tendency toward stabilization of employment, produce commodities for which the demand is inelastic or for which other products can be substituted with relative ease. In the case of tobacco products, greater mechanization was accompanied by an appreciable decline in the number of workers. The displacement becomes especially apparent when it is noted that during the years 1899–1914, when mechanization increased 59% while the number of wage earners increased only 35%, whereas in the fifteen years 1914–1929, when machinery equipment increased 87%, the working force declined more than one-third of the 1914 high. Although cigarettes were predominantly a machine-made product prior to 1917, the manufacture of cigars was primarily a hand process. During the war there was a switch in consumer demand from the cigar to the cigarette. This change in consumption was so great that from 1918 to 1929 the production of cigars decreased about 12%, whereas cigarettes increased approximately 160%.¹ Later in the decade after 1919, cigar-making

¹ United States Bureau of Labor Statistics, "Technological Changes in the Cigar Industry and Their Effects on Labor," *Monthly Labor Review*, December, 1931, pp. 11–17

machines were perfected and gradually adopted, until by 1929 approximately 35% of the total output was made by machinery.

The effects of inelasticity of demand are indicated in the lumber, leather, and stone, clay and glass industries. As a result of technological development, production has been increased without the aid of a larger body of workers. The leather industry consists chiefly of shoe manufacturing. There is a limit to the number of pairs of shoes that can be worn within a given time. Although consumer demand may be stimulated to some extent by the dictates of fashion or desire for variety, such as high-heeled shoes, oxfords, two-toned sport shoes, and dress shoes, nevertheless, such stimulation has not produced a sufficient expansion in demand to cause an increase in the labor force.

Furthermore, substitution of one commodity for another, either because of price or because the newer product is more attractive or efficient, has made itself felt particularly in the leather and lumber industries. For example, today rubber and composition belting is taking the place of leather; steel and other metal products are replacing lumber in construction. Increased demand for lumber and leather, created by developing new fields of usefulness, is thus being in part offset through the substitution of other commodities.

SUMMARY

From 1899 to 1929 the output per wage earner in manufacturing increased 68%, while weekly hours of work declined 14.8%. This increase in the output per worker was accompanied by an increase of 331% in mechanization, as measured by horsepower installed. Since, in addition to machinery and technological advances, non-mechanical improvements in methods of operation through the greater efficiency of management and labor have been responsible for the ability of the worker to produce more, it appears that an unusually

large amount of power is necessary to bring about a relatively small increase in output per worker.

Many machines, however, are not installed for the purpose of saving labor, but rather for the improvement in the quality of products or for the production of new commodities. The effect of mechanization is thus to create additional demand for goods, services, and labor, rather than to throw workers out of employment. For example, eighteen new manufacturing industries, which came into existence since 1879, employed 1,123,314 workers in 1929, or about one-eighth of all labor in the manufacturing industries in that year. These new industries accounted for 18% of the total increase in employment in manufacturing and for 40% of the increase in employment per million of population from 1879 to 1929.

These figures do not measure the total contribution of science, invention, and technology to the ability of the economic system to provide employment. They do not show the number of new jobs created outside of manufacturing and in connection with the transportation and distribution of goods and services produced by the newly created industries. Installation of machines made possible the release of wage earners from the manufacturing industries for work in other occupations.

Mechanization varies both in degree and in the rate of introduction from industry to industry, and from one process to another in the same industry. Fabricating processes are more highly mechanized than handling processes. There are wide areas in the industrial field that have barely been touched by technology, where a greater and more uniform use of mechanical devices can be beneficially applied.

Before the World War there was a rapid introduction of machinery and a steady increase in the labor force. During the World War a sharp increase in production was accompanied by approximately equal increases in the number of workers and in horsepower installed. The output per worker

in 1919 was smaller than in 1914. This decline was due primarily to a decline in the efficiency of the workers, who became indifferent and careless because of the tremendous demand for their services. From 1923 on, the progress of mechanization continued, although at a less rapid rate than before 1914.

Despite the increase in the use of machines and the progress in the efficiency of management and workers from 1919 to 1929, the actual number of wage earners in the manufacturing industries in 1929 was practically the same as in 1919, which was indisputably a year of abnormally high employment. Industries which advanced most rapidly along technological lines drew most heavily on the labor supply, while industries which were mechanized more slowly absorbed smaller portions of the available working force.

This relationship between increased employment and mechanization is due to the fact that machines decrease costs and prices, improve the quality of goods, and stimulate sales.

CHAPTER IV

MACHINERY, INCOME, AND PURCHASING POWER

IN the preceding chapters it was shown that during the period of most rapid mechanization, following the beginning of the century, the total volume of production had been enormously increased compared with both the total population and the working population, yet the proportion of the working population to the whole had not been reduced and there was no evidence of an increase in the unemployment rate. How have these changes, accompanying mechanization, been reflected during this period in changes in the income of the people and in the purchasing power of their income; that is, the ability of the people to buy the goods and services that were being produced in such greatly increased quantities with the assistance of the machine?

GROWTH OF THE NATIONAL INCOME

The most comprehensive measure of the income of the people is contained in the figures showing the net value of all goods and services produced by the entire economic system within a given period. The national income produced in a year, stated in terms of money, represents the market value of all goods and services produced in the year minus the value of raw materials and equipment used in their production. The income produced measures from year to year the volume of purchasing power available from current production for the satisfaction of the needs or desires of the people. If the total income increases more rapidly than the population and if the increase in money income is not due to higher prices, the standard of living of the people, their ability to buy things, is improved.

There are no reliable national income figures for the period prior to 1899. Since that year, annual estimates of national

income produced have been prepared by various individuals and organizations. While incomplete and uncertain in many respects, these estimates are sufficiently accurate to indicate the changes that have taken place from year to year in the value of the total national output and, when adjusted for variations that occur in the purchasing power of money, give a broad measure of changes in the national standard of living. Estimates of total national income, income per capita of population, and per gainful worker, compiled by the National Industrial Conference Board, are shown in Table 16 for the period 1899 to 1934. The figures are expressed in current dollars and in dollars of constant purchasing power computed on the basis of the changes in the cost of living as shown by the index compiled by the Federal Reserve Bank of New York. Table 17 presents the data in terms of index numbers. The year 1899 is chosen as a base in computing both the dollars of constant purchasing power in Table 16 and the index numbers in Table 17, not only in order to harmonize the figures with those in previous tables, but also because 1899 was a rather prosperous year, yet business activity was not so high as to be regarded as abnormal for purposes of comparison.

From 1899 to 1929 total national income in current dollars increased from \$15.6 billion to \$83.0 billion, or 432%. During the same period the increase in population was 62% and the increase in the number of gainfully employed was 69%. The per capita income, therefore, rose from \$209 to \$683, or 228%, and the income per gainful worker from \$547 to \$1,719, or 215%. During this period the purchasing power of income has greatly changed owing to fluctuations in the cost of living. If the increase in prices is eliminated, the purchasing power of total national income in 1929 was 140% greater than in 1899. During the same period the purchasing power of the income per gainful worker rose 42%, and that of per capita income increased 48%. If the year 1929 is re-

TABLE 16: ESTIMATED NATIONAL INCOME PRODUCED,
1899 TO 1934

Sources: Dr. Warren M. Persons, National Bureau of Economic Research, Federal Trade Commission, United States Department of Commerce, and National Industrial Conference Board

Year	Current Dollars			1899 Dollars		
	Total in Billions	Per Capita	Per Gainful Worker In- cluding Unemployed	Total in Billions	Per Capita	Per Gainful Worker In- cluding Unemployed
1899	\$15.6	\$209	\$547	\$15.6	\$209	\$547
1900	16.2	213	556	15.6	205	535
1901	18.3	235	610	17.2	221	573
1902	20.8	262	674	19.1	240	618
1903	21.1	261	664	18.5	228	581
1904	21.6	262	661	19.1	231	585
1905	25.1	298	747	22.2	264	661
1906	27.6	322	800	23.6	275	684
1907	28.2	322	796	22.9	261	645
1908	24.9	280	684	21.1	237	579
1909	27.2	300	727	23.0	253	616
1910	30.1	326	785	24.1	261	630
1911	29.4	314	761	23.6	252	610
1912	31.8	334	814	24.0	252	614
1913	33.7	350	857	26.0	269	659
1914	32.0	327	806	24.2	247	608
1915	34.5	347	860	26.0	262	648
1916	44.2	439	1,093	30.4	302	750
1917	53.2	521	1,304	30.4	297	743
1918	60.2	581	1,463	28.1	271	682
1919	67.4	642	1,623	27.9	266	671
1920	74.3	697	1,770	26.8	252	640
1921	52.6	486	1,233	23.0	213	540
1922	61.7	562	1,423	28.5	259	657
1923	69.8	626	1,584	31.6	284	718
1924	69.6	615	1,555	31.5	279	705
1925	77.1	671	1,695	33.9	295	747
1926	78.5	674	1,699	34.5	296	748
1927	77.2	653	1,647	35.0	296	746
1928	80.5	671	1,691	36.2	302	762
1929	83.0	683	1,719	37.4	308	774
1930	70.3	571	1,436	32.6	265	666
1931	54.6	440	1,107	27.9	225	565
1932	39.4	315	793	22.0	176	443
1933	41.8	333	836	24.6	195	492
1934	47.6	377	946	26.8	212	532

garded as a year of abnormal prosperity and comparisons are made with 1927, the same striking improvement in total income and in the purchasing power of income is evident. In 1927, for example, the value of goods and services produced was 395% greater than in 1899, while the purchasing power of the national output rose 124%. The purchasing power of per capita income was 42% and of the income per gainful worker 37% greater in 1927 than in 1899.

The rise in income has been much more rapid than the increase in the number of consumers as represented by the total population; it has also been more rapid than the increase in the working population, that is, in the number of persons who are normally employed. With the exception of temporary declines which occurred in periods of depression, there has been a steady increase in the purchasing power of the people and in the standard of living. In 1934, the national income both in terms of money and in terms of purchasing power was greater than at the beginning of the present century; the income per capita of population was also greater, although more than 10,000,000 persons were out of work. In spite of enormous unemployment and an unusually low level of business activity, the output of the productive system of 1934 provided the total population, the employed and the unemployed, with a higher standard of living than was available to the much smaller population out of the national production in the relatively prosperous year of 1899.

National income figures, however, do not fully reflect the general advance in the standard of living, because they do not take into consideration the improvement that has been made in the quality of goods and services and the reduction in the length of the working day. Prices of many commodities and services may not have materially declined over a period of time, but the improvement in quality has increased the usefulness or the satisfactions which the consumers derive from the use of such commodities and services, thus contributing

TABLE 17: INDEX NUMBERS OF NATIONAL INCOME
PRODUCED, 1899 TO 1934Source: Based on figures shown in Table 16
1899 = 100

Year	Current Dollars			1899 Dollars		
	Total	Per Capita	Per Gainful Worker Including Unemployed	Total	Per Capita	Per Gainful Worker Including Unemployed
1899	100	100	100	100	100	100
1900	104	102	102	100	98	98
1901	117	113	112	110	106	105
1902	133	126	123	122	115	113
1903	135	125	122	118	109	106
1904	138	125	121	123	111	107
1905	161	143	137	142	126	121
1906	177	154	146	151	132	125
1907	181	155	146	147	125	118
1908	160	134	125	135	113	106
1909	174	144	133	147	122	113
1910	193	156	144	155	125	115
1911	189	151	139	151	121	112
1912	204	160	149	154	121	112
1913	216	168	157	167	129	121
1914	205	157	147	155	118	111
1915	221	166	157	167	126	119
1916	283	210	200	195	145	137
1917	341	250	238	195	142	136
1918	386	279	267	180	130	125
1919	432	308	297	179	127	123
1920	476	334	324	172	121	117
1921	337	233	226	148	102	99
1922	396	269	261	182	124	120
1923	448	300	290	203	136	131
1924	446	295	285	202	134	129
1925	494	322	310	218	142	137
1926	503	323	311	221	142	137
1927	495	313	301	224	142	137
1928	516	322	309	232	145	139
1929	532	328	315	240	148	142
1930	451	274	263	209	127	122
1931	350	211	203	179	108	103
1932	252	151	145	141	84	81
1933	268	159	153	157	94	90
1934	305	181	173	171	101	97

CHART 17: INDEX NUMBERS OF NATIONAL INCOME
PRODUCED, IN 1899 DOLLARS, 1899-1934
1899=100



materially to a higher standard of living. The automobile of today, for example, is far superior to the automobile of even a few years ago, but is being sold without any increase in price. The price of a radio at the present time may not be different from the 1921 price, but the service rendered by the instrument has in the meantime been greatly improved. The consumer, therefore, obtains a better product with the same expenditure; the improvement in quality represents an addition to his standard of living. These two examples illustrate in a striking manner the gain in real income through the improvement in quality. Examination of changes in the quality of many other goods and services would unquestionably show that their total effect has been a marked rise in the standard of living without any increase in money income and without a decrease in prices.

With respect to hours of work, there is no satisfactory information for the working population as a whole. It has already been shown that the proportion of the population gainfully occupied has remained substantially unchanged from 1900 to 1930. During the same period it is estimated that the average number of hours worked per week in all occupations has declined between 10% to 15%.¹ While this is a general and somewhat uncertain estimate, as applied to the whole working population, more accurate information regarding average hours of work per week is available for the manufacturing industries. The following table shows the figures for the average weekly hours of work from 1899 to 1929:²

Year	Hours	Year	Hours
1899.....	56.8	1921.....	45.6
1904.....	55.5	1923.....	49.2
1909.....	54.6	1925.....	48.2
1914.....	51.5	1929.....	48.4
1919.....	50.3		

¹ Maurice Leven, Harold G. Moulton, and Clark Warburton, "America's Capacity to Consume," The Brookings Institution, Washington, D. C., 1934, p. 150.

² National Industrial Conference Board, "The Thirty-Hour Week," New York, 1935, p. 17.

The decline in average weekly hours of work in the manufacturing industries from 1899 to 1929 was 14.8%. During the same period the output per man-hour increased 98%; the output per wage earner rose 68%; the number of wage earners rose 88%; the quantity of production, 216%; and horsepower installed, 331%. The increased leisure of the workers, therefore, did not take place at the expense of production, because machinery has enabled the working population to produce more with less expenditure of time.

DISTRIBUTION OF NATIONAL INCOME BY ECONOMIC GROUPS

Figures of national income produced, expressed in dollars of constant purchasing power, are a good measure of the changes that have taken place in the productiveness of the economic system. They show that the total income, or the national production of goods and services, has increased more rapidly than the total population and more rapidly than the number of gainfully employed, but they do not show the amounts paid out to groups of individuals. Estimates of the amounts paid out to wage earners, salaried employees, persons in business for themselves, and investors have been prepared by Professor Willford I. King for the period 1909 to 1927¹ and by the Department of Commerce for the period 1929 to 1934.² On the basis of Professor King's figures, the Brookings Institution has prepared an estimate for 1900.³

These various estimates, while constructed in different ways, justify one important general conclusion: During the period of rapid mechanization of the productive system the amounts paid to wage earners and salaried employees have increased more rapidly than total income. In other words, an increased proportion of the total national product has

¹ Willford I. King, "The National Income and Its Purchasing Power," National Bureau of Economic Research, New York, 1930, p. 80.

² Robert R. Nathan, "The National Income Produced 1929-34," Mimeographed, United States Department of Commerce, Washington, D. C., 1935, p. 9.

³ "America's Capacity to Consume," *op. cit.*, p. 158.

been going to labor in the form of wages and salaries. The proportion going to investors has remained substantially unchanged, while the share of persons in business for themselves has declined. According to Professor King, the proportion of total income going to wage earners and salaried employees¹ increased from 51.0% in 1909 to 58.2% in 1927. The Brookings Institution states that the share of employees rose from 53.2% in 1900 to 65.1% in 1929. During the business depression of 1930-34 the proportion of total national income paid out to wage earners and salaried employees showed an increase. The proportion of income going to investors remained practically unchanged during the period, while the share of persons who are in business for themselves declined. The decline in the share going to entrepreneurs was due in a considerable degree to a decrease in their number owing to shifts from entrepreneurial to salaried occupations.

WAGE RATES AND ANNUAL EARNINGS OF WAGE EARNERS

According to Professor King's figures, total payments to employees increased from \$15,090 million in 1909 to \$51,360 million in 1927, or 240%; the income per wage earner rose from \$527 to \$1,205, or 129%; and the income per salaried employee from \$976 to \$2,084, or 114%.² These averages do not represent the average income or annual earnings of employed workers because they include all persons who are classified as gainfully occupied employees regardless of whether or not, or for how long a period, they had jobs during the year. In periods of depression, therefore, the average income per wage earner, shown by such figures, declines greatly, because of the great increase in unemployment.

Relating these changes in the average share of the national income available per employee to changes in the purchasing value of the dollar for commodities and services bought at

¹ Including pensions, compensations, and similar payments.

² King, *op. cit.*, pp. 122, 146, 158.

retail, it is seen that the average real income available per employee increased in 1913 dollars 27% for wage earners and 18% for salaried workers during this period.¹

The comparisons and changes described in the foregoing part of this chapter provide a general measure of the rise in the standard of living, or quantity of goods and services available for the population as a whole and for the working population, during a period of rapidly increasing productiveness of the industrial organization brought about largely by mechanization, and in part by improvements in organization and management.

The effect upon the standard of living of the increased productiveness of industry due to mechanization is measured more directly by the change in the purchasing power of an hour of labor effort over this period. Changes in wage rates, of course, do not measure changes in total income of the working population, of wage earners, or of any group of them, because total income depends upon the amount of employment obtained. It has been shown that the average weekly working hours in manufacturing have declined about 15%; but no adequate data exist by which to measure the average total number of hours of employment secured annually by wage earners, taking into account average amount of idleness per worker due to illness, injury, seasonal fluctuations, intermittent unemployment, etc.

Though wage rates are not a measure of total income, they can be related to the price of goods and services to provide a definite and direct measure of changes in the amount of those goods and services which a worker can secure for an hour's labor. While the wage data available for such comparisons, though indicating only general averages, are fairly specific, the only data on prices are of two kinds: combinations of prices of commodities at wholesale; and combinations of prices at retail of goods and services sup-

¹ *Ibid.*, p. 87.

posed to represent the purchases of wage earners. Since, however, the purpose of these comparisons of wage rates and prices is not to measure changes in the actual real income of workers but to measure changes in the amount of a given kind of goods and services which wage earners can get for an hour's work, it is not important which kind of price index is used.

TABLE 18: INDEX NUMBERS OF HOURLY WAGE RATES, COST OF LIVING, AND WHOLESALE PRICES, 1899 TO 1929
1899 = 100

Year	Wage Rates, All Occupations ¹	Wage Rates, All Non- Agricultural Occupations ²	Cost of Living ¹	Wholesale Prices ²
1899	100	100	100	100
1904	114	114	113	114
1909	128	129	118	130
1914	146	146	132	130
1919	257	263	242	266
1921	281	311	229	187
1923	297	310	221	193
1925	309	323	227	198
1927	319	330	221	183
1929	326	333	222	183

¹ Federal Reserve Bank of New York.

² Bureau of Labor Statistics.

Changes in hourly wage rates from 1899 to 1929 in all occupations and in all non-agricultural occupations are given in Table 18. As compared with 1899, the average amount of money received by wage earners as a whole for one hour of work was 226% higher, while the average amount received by wage earners, exclusive of agricultural workers, was 233% higher. During the same period the retail prices of a representative group of goods and services bought by wage earners, as measured by an index of the cost of living, increased 122%, indicating an improvement in the purchasing power of an hour's work of 47% for wage earners as a whole, and 50% for non-agricultural workers. Wholesale prices increased only 83%, that is, the amount of goods at wholesale, which

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could be bought for an hour's work rose 78% for all wage earners and 82% for non-agricultural wage earners.

Wage-earner income during the year is the result of the rate received per hour and the number of hours worked. No accurate measure of annual earnings is available. The Census of Manufactures, however, reports for each census year the average number of wage earners employed and the total amount paid in wages. The average number of wage earners is obtained by adding together the number of wage earners employed at the middle of each month and dividing the total by twelve. If the total amount paid in wages is divided by the average number of wage earners, the result is average annual earnings per wage earner if all wage earners had been employed full time. The census average wage refers to an artificial and hypothetical person. The census does not classify separately, in respect to wages, male, female, and juvenile employees, and it makes no distinction between skilled and unskilled labor. "It must never be assumed," states the 1905 census report, "that the result (of dividing wages by wage earners) shows the average annual earnings of a machinist or of a weaver, or of a laborer, or of a wage earner in any other occupation; or that it is the earnings of the average person working a whole year, or those of a group employed six months, or a month, or any other period of time. . . . This average unit is the average of wage earners of heterogeneous occupations and rates of pay, working for varying lengths of time, in each industry, each state, and the United States, respectively. But it gives a quantitative statement of average annual earnings, which is the only statement easily grasped; presents a general idea regarding wage earners as a whole; and furnishes results by which, character of elements and methods of computation being clearly stated and understood, complex conditions can be interpreted."¹

¹ Cited in Paul F. Brissenden, "Earnings of Factory Workers, 1899 to 1927," Census Monographs X, Washington, D. C., 1929, p. 273.

The improvement in the uniformity of collection and presentation of census information since 1899 makes the census average a useful measure of the degree of change in per capita full-time earnings of wage earners in manufacturing industries. This study is primarily concerned with changes in the purchasing power of earnings during the period of mechanization. These changes are reflected fairly accurately in changes of census average wages expressed in the form of index numbers in terms of dollars of constant purchasing power.

TABLE 19: WAGE EARNERS, TOTAL WAGES, AND AVERAGE WAGES PER WORKER, MANUFACTURING INDUSTRIES, 1899 TO 1929

Source: United States Bureau of the Census

Year	Average Number of Wage Earners	Wages In Thousands	Census Average Wages per Wage Earner	Index Numbers, 1899 = 100			
				Wage Earners	Total Wages	Wages per Wage Earner	Real Wages per Wage Earner ¹
1899	4,712,763	\$2,008,361	\$426	100	100	100	100
1904	5,362,030	2,610,445	487	114	130	114	101
1909	6,472,616	3,427,038	529	137	171	124	105
1914	6,896,190	4,067,719	590	146	203	138	104
1919	9,000,059	10,461,787	1,162	191	521	273	113
1921	6,946,570	8,202,324	1,181	147	408	277	121
1923	8,778,156	11,009,298	1,254	186	548	294	133
1925	8,384,261	10,729,969	1,280	178	534	300	132
1927	8,349,755	10,848,803	1,299	177	540	305	138
1929	8,838,743	11,620,973	1,315	188	579	309	139

¹ Using index of cost of living compiled by Federal Reserve Bank of New York.

Table 19 shows the average number of wage earners, total wages paid, and average wages obtained by dividing the total amount paid in wages by the average number of wage earners for the period 1899 to 1929. It also contains index numbers showing changes in the number of wage earners, total and average wages, and "real wages" obtained by eliminating fluctuations in the cost of living. From 1899 to 1929 the average number of wage earners increased 88%; total wages

paid increased 479%; and wages per wage earner rose 209%. The cost of living during the same period increased 122%, indicating an increase in the purchasing power of full-time per capita annual earnings of 39%.

Figures of real annual earnings, estimated by Professor Brissenden on the basis of the census average wage and hypothetical full-time weekly earnings, show that in 1927

TABLE 20: INDEX NUMBERS OF AVERAGE WEEKLY EARNINGS, COST OF LIVING, AND REAL WEEKLY EARNINGS, 25 MANUFACTURING INDUSTRIES, 1914 TO 1935

Source: National Industrial Conference Board
July, 1914=100

Date	Weekly Earnings	Cost of Living	Real Weekly Earnings
1914 July	100	100	100
1920 ¹	231	191	121
1921	188	166	114
1922 ¹	192	157	122
1923	210	161	130
1924	209	164	127
1925	214	167	128
1926	216	167	129
1927	217	164	133
1928	220	162	136
1929	225	161	139
1930	204	155	131
1931	179	140	128
1932	135	125	107
1933	140	121	116
1934	159	128	124
1935	176	134	131

¹ For the last six months of the year.

the buying power of the manufacturing worker's earnings, in terms of living costs, was 34% higher than in 1899 and that since that year real earnings have increased at an average rate of about 1% per year. These figures correspond quite closely with the changes in purchasing power shown by the index derived from the census average wage. Both series of figures show not only that the total amount distributed in wages increased more than the total number of wage earners during the period from 1899 to 1929, but that

wage earners as a group were able to buy an increasing amount of goods and services with the money received for their labor.

Further evidence of the increase in real earnings can be found in data compiled by the National Industrial Conference Board. The Conference Board has computed figures of weekly earnings for July, 1914, and with the exception of the first six months of 1922, for each month since June, 1920. The figures relate to all wage earners, male and female, skilled and unskilled, in representative samples of 25 manufacturing industries. If the index of actual weekly earnings is divided by the index of the cost of living, it is seen that in 1929 the purchasing power of the average wage earner's weekly earnings was 39% greater than in July, 1914, as shown in Table 20. During the business depression the purchasing power of weekly earnings declined to a low point of 97% of the 1914 level in the summer of 1932. Since that time the purchasing power of weekly earnings has been increasing rapidly. In August, 1935, it was 31.1% higher than in July, 1914.

SUMMARY

During the period of the rapid mechanization of the industrial system, the total volume and value of the goods and services produced and available for the satisfaction of the needs and desires of the people have increased more rapidly than the increase in population or in the number of gainful workers. The increase in total production and in per capita income has been greater than the increase in prices. In 1934, in spite of enormous unemployment and depressed business, the output of the productive system provided for the entire population, the employed and the unemployed, a higher standard of living than the output of 1899 when business was good and the population much smaller.

The increase in the purchasing power of the national income does not fully reflect the improvement in living standards, because it does not take into account the great improvement that has been achieved in the quality of goods, and the decline in the hours of work. The improvement in the quality of goods and the rise in the standard of living from that source cannot be precisely measured. The average number of hours of work per week during the period has declined approximately 15%.

The proportion of total income going to wage earners and salaried employees has increased from 1899 to 1934. The proportion going to investors has remained practically unchanged, while the share of persons in business for themselves has declined.

From 1899 to 1929 there has been a great increase in the purchasing power of an hour's work in terms of the cost of living and a considerably higher increase in the price of an hour of work in terms of wholesale prices.

The best available information concerning annual per capita earnings of wage earners in manufacturing industries indicates that the purchasing power of per capita annual earnings has increased greatly from 1899 to 1929.

Examination of the trends in the value of the total national output of goods and services, in comparison with the growth of population and gainfully occupied, the share of labor in this total, the value of an hour of work, the total amount paid in wages by the manufacturing industries, the per capita annual and weekly earnings of wage earners, and the purchasing power of earnings, indicates clearly that there has been a great improvement in the standard of living of the people within a short period of thirty years. The increased use of machinery in production, together with improvements in organization and management, have made this possible.

CHAPTER V

DEVELOPMENTS DURING THE DEPRESSION AND THE OUTLOOK

THE discussion in the preceding chapters has been limited chiefly to the developments up to the outbreak of the current business depression. In every depression during the past one hundred years, the notion that the machine is primarily responsible for depression and for the resulting unemployment has been popular. The purpose of this chapter is to throw some light on the relationship of the machine to the status of the worker during the depression and on the probable effects of mechanization on employment in the future.

From 1922 to 1930 the economic system of the United States functioned, on the whole, without marked ups and downs and the volume of production and trade showed a slow but steady increase. During this period practically the entire available labor force in the country was gainfully employed. The workers who were laid off in one plant or industry found employment within a reasonably short time in some other plant in the same industry or in some other occupation. The 48-hour week prevailed in most industries. In other words, from 1922 to 1930 practically the entire working force, working at least 48 hours per week, was required to produce the goods and render the services used by the people. Unemployment during this period was due largely to old age, sickness, injuries, seasonal fluctuations, and occasional layoffs because of shutdowns for repairs and business failures. Whatever technological displacement may have occurred during this time could not have been of any consequence from the point of view of unemployment.

During the business depression, unemployment increased from an average of about two million persons in 1929 to the estimated number of over 13 million in the early part of 1933. Since that time business recovery has brought about some reduction in unemployment, but the current estimate still remains alarmingly large.

The question has been raised concerning the extent to which the inability of these millions of workers to find employment is due to the introduction of machinery and technological improvements during the business depression.

INCREASED OUTPUT PER MAN-HOUR

The rapid increase in output per man-hour during the depression is interpreted by some persons as proof that there has been a vast mechanization of industrial processes and that this mechanization prevents re-employment of labor. Estimates of the increase in man-hour productivity of labor in the manufacturing industries range from 16% to 25%.¹ Assuming that the actual increase lies somewhere between these two extremes, about 20%, it might appear from a superficial examination of the facts that there has been considerable displacement of labor by machines during the depression.

It should be pointed out that the term "output per man-hour" implies a degree of causal relationship between labor and production which in fact does not exist. It is not, as it is often assumed, a measure of the amount of output the work of one man for one hour will produce. It is merely one way, and not a very good way, of measuring production. The laborer's contribution is but little, if at all, larger today than it was thirty years ago. The preceding chapters of this book have proved, it is believed, that the extraordinary increase in production per capita that has taken place since the beginning of the century has been due almost entirely to

¹ "The Thirty-Hour Week," *op. cit.*, p. 19.

mechanization, and that the high standard of living, the many additional luxuries and comforts we now enjoy, the lightening of the task of labor, the shortening of work time, and the expansion of the field of gainful employment, are to be credited to the machine and to the substitution of mechanical power for man power.

The machine has given us more production, with less labor and in less time. This increase in production in proportion to human effort, which has widened, not diminished, the field of employment, has been the greatest contribution of the twentieth century to the economic and social welfare of the American people. It is to be hoped, and it may reasonably be expected, that it will continue.

The increase in output per worker during recent years does not represent a permanent gain in the efficiency of industry, and is not due entirely or even largely to new or better machinery and technological improvements. Other forces which become operative in a period of business depression contribute to bring about an increase in the output per man employed. The workers who are kept on the payroll while the labor force is being reduced, are usually the most efficient members of the force. The output per man of this group of workers is naturally higher than that of the larger working force employed in good times. There is a corresponding use of the better machines in the existing equipment. Furthermore, during the depression the need for drastic economies forces the management to reduce waste to the minimum, to shut down the less efficient plants, to discontinue unnecessary departments and services, and in general to introduce drastic economies all along the line of production and distribution in an effort to maintain markets during a period of declining demand. Efficient management is especially important where there is rigidity of wage rates as a result of labor organization policy, government intervention, or prevailing practice. Finally, at a time when the supply of labor

is very large and competition for available jobs very keen, the efficiency of the employed workers is greatly increased because of their desire to be kept on the payroll.

It would be a mistake to assume that in the event of business revival the influence of these forces on the output per worker would remain unimpaired. Business revival would relieve management of the imperative necessity for economizing and would lead to re-employment of the less efficient workers and of the workers who during prolonged unemployment have lost a large part of the efficiency which they have had before they lost their jobs.

That such re-employment will necessarily involve a lowering of the efficiency of the working force maintained during the depression is shown in a recent study of the Conference Board.¹ This study discusses the experience which 287 companies in the metal-working industries have had in recent times in securing skilled workers. Although applicants for skilled positions were abundant, only a small proportion of these possessed the necessary skill. In many cases the companies were unable to find the required type of labor. The study of the Conference Board estimates a shortage of about 19,000 skilled workers in the late spring of 1935 and points out that in the event of a return of business activity to the pre-depression level the shortage would be over six times greater.

This dearth of skilled labor at a time when millions of workers are unemployed is due to the loss of skill and ability during the periods of prolonged unemployment. "Years of loafing, puttering around at odd jobs, or leaning on a shovel in a relief gang, have broken their high standards and morale. . . . But most disastrous is the physical and mental deterioration which, unknown to them, has sapped their energy and vitality and broken their morale."²

¹ National Industrial Conference Board, "Wanted: Skilled Labor," New York, 1935.

² *Ibid.*, p. 5.

Another cause for the shortage of skilled labor is the practically complete discontinuation of training of new workers for skilled occupations.

Evidence that the increased output per man employed by industry during the business depression was due to causes other than machinery and technological improvements is found in the almost complete cessation of activity in the industries producing machinery. The index of orders for machine tools, as compared with 1926 figures, declined from 156 in 1929 to 41 in 1931, to 20 in 1932, and rose only to 27 in 1933, and 46 in 1934.

It is clear that the basic reason for the increase in the output per man during the depression was not mechanization, modernization, or renovation of plants, but rather the greater efficiency of labor and management which always takes place during a period of depression and which diminishes with the return of prosperity.

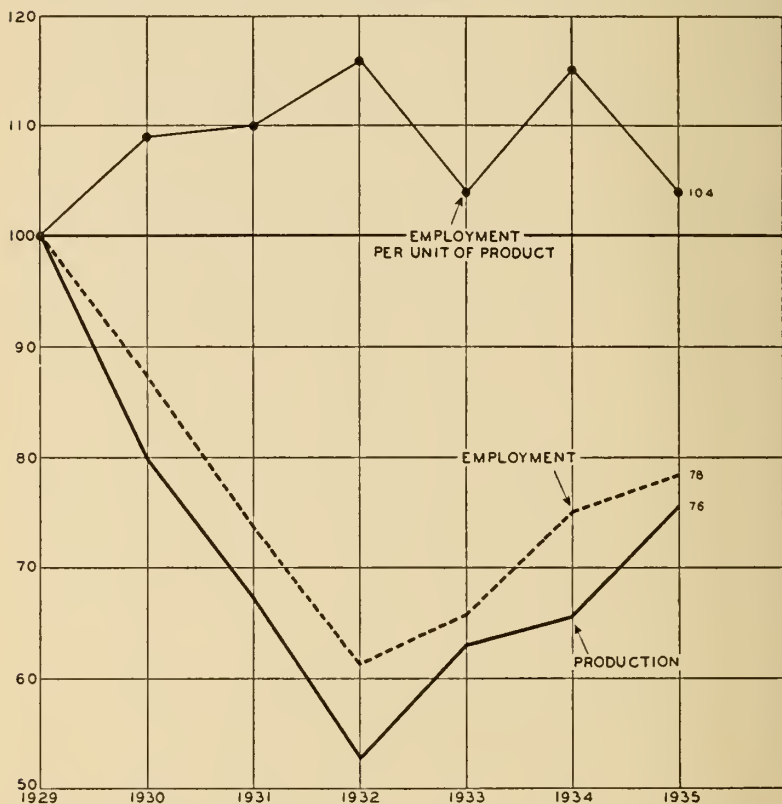
OUTLOOK

During the period of its most rapid development, from 1879 to 1929, machinery has been responsible for the establishment of many new industries; it has created new opportunities for employment; it has released workers from industries producing goods to trade and service occupations; it has stabilized employment by increasing the proportion of the gainful population engaged in trade and service industries; it has made possible an enormous increase in the total volume of production by increasing the output per man; it has reduced hours of work. In general, the use of machinery has been the chief cause of the great improvement that has occurred in the purchasing power and the standard of living of the masses of the people.

From 1929 to 1935 the general contraction in business activity was accompanied by an even more severe decline in the production of machinery and machine tools. The increase

in the output per man which took place during the years of the depression was not so much due to the introduction of machinery and technological improvements as to the greater

CHART 18: INDEX NUMBERS OF PRODUCTION AND EMPLOYMENT, MANUFACTURING INDUSTRIES, 1929-1935
1929 = 100



efficiency of the working forces and drastic economies introduced by management all along the line of production and distribution. Unemployment during the business depression was not due to the fact that goods were being produced by machines instead of by men, but to the fact that goods were

not being produced in sufficient volume. The answer to the problem of unemployment does not lie in placing restrictions on the use of machinery, but in the eventual increase of the volume of production, which would increase the purchasing power of the people and lead to full re-employment.

The series of index numbers presented in Table 21 and Chart 18 indicate the relationship between production and employment from 1929 to 1935. In terms of monthly averages, production reached a point 47% below the 1929 level

TABLE 21: INDEX NUMBERS OF PRODUCTION AND
EMPLOYMENT, MANUFACTURING INDUSTRIES,
1929 TO 1935¹

Sources: Federal Reserve Board and United States
Bureau of Labor Statistics
1929 = 100

Year and Month	Total Manufacturing		
	Production	Employment	Employment per Unit of Production
1929	100	100	100
1930	80	87	109
1931	67	74	110
1932	53	61	116
1933	63	66	104
1934	66	75	115
1935	76	78	104

¹ Unadjusted for seasonal variation.

in 1932, while the decline in employment was only 39%. Yet in this same year the index of employment per unit of production marked the highest point reached during the six-year period. The fact that throughout the depression years employment in proportion to output has been maintained above the 1929 level is convincing proof that every device was utilized to keep as many men at work as possible. It is true that the short-time work week was nearly universal, but employers elected to close their plants for part of the week, rather than to reduce more than was absolutely necessary the

number of employees on the payroll. From a strictly business standpoint, continuous operation, with a minimum number of selected employees, would have been the proper method of adjustment to existing conditions.

The manufacturing industries are usually divided into industries producing consumers' goods and those producing producers' goods. For various reasons, some of them related to certain governmental policies, producers' goods industries, which require long-term capital for their development, have recovered less from the depression than consumers' goods industries, but in both groups recovery in production has been accompanied by increased employment. The fact that the elimination of part-time work has preceded the hiring of additional workers explains the failure of employment to increase in proportion to the increase in output.

In the textile industry, for example, the volume of production in 1932 was 28% lower and the number of workers 27% lower than in 1929. In 1934, a labor force only 13% smaller than in 1929 was employed to produce the output which was 26% below that of 1929.

In the automobile industry the volume of production in 1932 was only 26% of the 1929 amount, while the number of workers employed declined to 55%. In 1934 production increased to 51% and the number of workers to 84% of the 1929 average. In April, 1935, when the volume of production was 4% above the 1929 level, the number of workers employed was 8% larger than the average number working in 1929.

In the iron and steel industry, which produces durable and producers' goods, the quantity of production in 1932 was 76% lower and the number of workers 48% lower than in 1929. The recovery in business from 1932 to 1934 brought the volume of production up to 46% and the number of workers up to 67% of the 1929 level. In June, 1935, iron and steel production was 49% lower than the 1929 average, but

the number of workers employed was only 30% below that of 1929.

The recovery in employment accompanying the recovery in the volume of production since the low point of depression indicates that there has been no extensive introduction of machinery and technological improvements and that the productive industries of the country will require as large a working force as was needed in 1929 to produce the output of 1929. Since 1929, however, the labor supply of the country has increased by approximately 1,800,000 workers owing to the increase in population. Past experience shows that increased production and continued development of new industries and new fields of service have always absorbed the annual increase in the supply of labor. There is no reason to believe that in the future this process will not continue and that in addition there will not be a great expansion in the use of the products and services developed during the past fifty years, but which still remain in the class of expensive or luxury articles.



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